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ASTM BULLETIN

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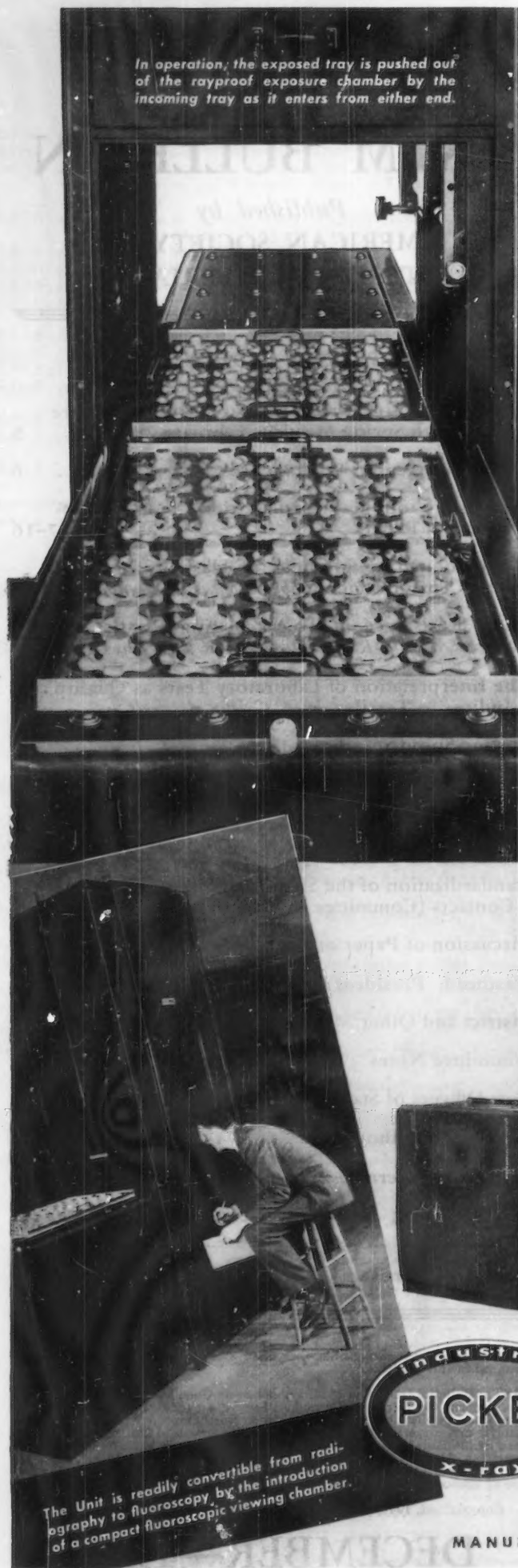
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DECEMBER—1944

No. 131



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"Promotion of Knowledge of Materials of Engineering, and Standardization of Specifications and Methods of Testing"

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Number 131

December 1944

Symposium on Corrosion Prevention to Feature Pittsburgh Spring Meeting, February 28, 1945

1945 Committee Week Will Be Held February 26 to March 2, 1945

UNDER THE AUSPICES of the Pittsburgh District Committee, a Symposium on Corrosion Prevention will be the technical feature of the Society's 1945 Spring Meeting to be held at the Hotel William Penn, Pittsburgh, Wednesday, February 28. This meeting will be held during A.S.T.M. Committee Week which extends from February 26 through March 2, 1945. A large number of committees are expected to meet at this time.

Further details of the meeting, hotel reservation forms, and related material will be sent to the members well in advance of the indicated dates.

Pittsburgh has been the scene of some of the Society's most successful meetings, notably the 1943 Annual Meeting, and earlier Spring Meetings were held there in 1931 and 1936.

The Pittsburgh District Committee under the chairmanship of Thomas Spooner, Manager, Engineering Laboratories, and Standards Department, Westinghouse Electric and Manufacturing Co., East Pittsburgh, Pa., will serve as hosts for the meeting and, as indicated above, are also arranging an interesting technical symposium.

Technical Program of Spring Meeting

During the past several years, the Society has had a number of distinctive symposiums with several publications resulting—covering weathering, corrosion, and related subjects. In 1934 there was the Symposium on Outdoor Weathering of Metals and Metallic Coatings. In 1937 a related subject was covered—correlating accelerated laboratory and outdoor tests on coatings, and in 1938 the Detroit District Committee held its symposium on Protecting Metals Against Corrosion. This pamphlet was widely distributed and is now out of print. Meanwhile there have been important developments in this field, and the suggestion of the Pittsburgh group that it develop discussions on corrosion prevention has been heartily approved by the Society's Committee on Papers and Publications.

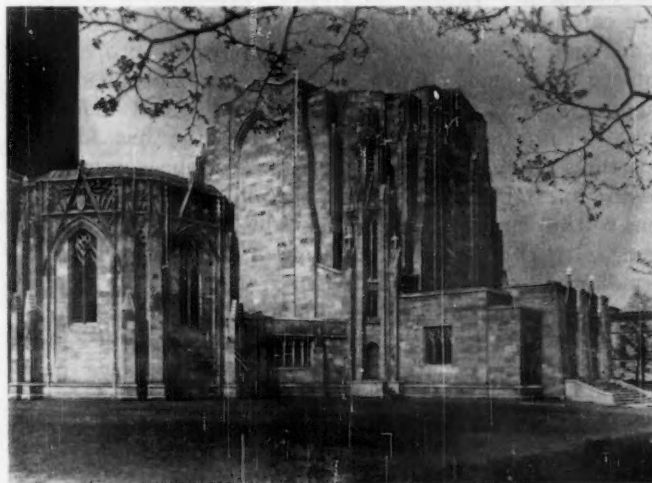
While more complete details of the technical program will be announced in the January BULLETIN and by direct mail, the symposium will be held at two sessions—afternoon and evening. The afternoon session will cover methods of cleaning, coatings used during manufacture, and coatings for shipment and storage. Another feature

is a paper on ceramic coatings for corrosion resistance at high temperatures. A discussion on metallic coatings, and organic, synthetic, and supplementary finishes are the evening topics. Thus the committee will include materials and treatments for a long-time protection, and also those affording more temporary conditioning against corrosion and rusting.

A number of leading authorities are being asked to contribute, including officers of A.S.T.M. committees which are active in many of these fields.

1945 A.S.T.M. Committee Week

It is expected that many of the Society's technical committees will hold meetings during Committee Week, extending from February 26 through March 2. By arranging meetings with a minimum of conflicts, an opportunity is afforded hundreds of A.S.T.M. people who serve on different technical groups to concentrate their work in a short period, thus avoiding attendance in various localities at different times. Each committee member will receive from the respective groups advance notification of meetings and in the January BULLETIN a list of standing committees planning to meet will be published.



Stephen Collins Foster Memorial Building

Commemorates one of America's foremost composers, born in Pittsburgh. The museum contains originals of his various songs, letters, and other items.

December 1944

ASTM BULLETIN

5

Additional Actions on Standards

Society Approves a Number of Regular and Emergency Recommendations

VARIOUS RECOMMENDATIONS from the Society's standing technical committees have been approved by A.S.T.M. Committee E-10 on Standards in the past few weeks, these actions having been taken for the most part by letter. A few of these items were listed in the October BULLETIN with no news comment since they became effective just as the BULLETIN was going to press.

Steel Rails:

In order that the Emergency Alternate Provisions EA - A 1 affecting the Standard Specifications for Open-Hearth Carbon-Steel Rails (A 1 - 39) would be in line with the latest War Production Board rulings, a revision has been incorporated by which the time at which the control temperature in the control cooling practice is not to result in any drop in temperature below 300 F. is to be seven hours—the present figure, for all rails 100 lb. or over per yard, but to be five hours for rails less than that weight. In making this change references to the respective A.R.E.A. publications are provided.

The WPB order affecting this situation was issued on July 25.

Stainless Pressure Tubing Specifications:

The four new tentative specifications noted in the accompanying list covering various types of stainless steel pressure tubing were developed in a joint subgroup headed by J. J. B. Rutherford, Babcock & Wilcox Tube Co., this group being sponsored jointly by Committees A-1 on Steel and A-10 on Iron-Chromium, Iron-Chromium-Nickel and Related Alloys. While there has been interest for some years in the possibility of standardized specifications it was not until a National Emergency Steel Project group on tubular products had initiated drafts of specifications that the matter was referred to the two A.S.T.M. committees. Meanwhile, the A.I.S.I., through its pipe and tubing group, had developed specifications which were carefully considered by the A.S.T.M. joint group. In addition to methods of testing, physical properties required, and such matters, there were real problems in reaching a decision on handling the chemical requirements. The change in the scrap situation has forced departures from normal chemistries, and the committee decided to establish a series of emergency alternate provisions so that current production could be concentrated on these, with the compositions that may come back into normal production listed in the tentative standards.

There has been a real need for standard requirements in this field and it is hoped the specifications will be of widespread service. The subcommittee in charge has really carried out some very intensive work and has had numerous discussions and there has been much correspondence in reaching agreement on the various points involved. The new tentative specifications will be included in Part I of the 1944 Book of Standards. The emergency provisions will also be in these books and are published in the latter portion of this BULLETIN.

Recent Actions by Committee E-10 on Standards

NEW TENTATIVE STANDARDS

Specifications for:

- Seamless and Welded Ferritic Stainless Steel Tubing for General Service (A 268 - 44 T).
- Seamless and Welded Austenitic Stainless Steel Tubing for General Service (A 269 - 44 T).
- Seamless and Welded Austenitic Stainless Steel Tubing for the Dairy and Food Industry (A 270 - 44 T).
- Seamless Austenitic Chromium-Nickel Steel Still Tubes for Refinery Service (A 271 - 44 T).
- Sampling and Testing Turpentine (D 233 - 44 T).

REVISION OF TENTATIVE STANDARDS

Specifications for:

- Oxygen-Free Electrolytic Copper Wire Bars, Billets, and Cakes (B 170 - 44 T).
- Aluminum-Base Alloys in Ingot Form for Sand Castings (B 58 - 44 T).
- Aluminum-Base Alloys in Ingot Form for Permanent Mold Castings (B 112 - 44 T).
- Aluminum-Base Alloys in Ingot Form for Die Castings (B 125 - 44 T).

TENTATIVE REVISION OF STANDARD

Methods of:

- Test for Magnetic Properties of Iron and Steel (A 34 - 44).

WITHDRAWAL

Methods of:

- Sampling and Testing Turpentine (D 233 - 36).

REVISIONS OF EMERGENCY ALTERNATE PROVISIONS

Specifications for:

- EA - A 1a Open-Hearth Carbon-Steel Rails (A 1 - 39).
- EA - B 23b White Metal Bearing Alloys (Known Commercially as "Babbitt Metal") (B 23 - 26).
- EA - B 32b Soft Solder Metal (B 32 - 44 T).
- EA - D 574b Insulated Wire and Cable: Ozone-Resistant Type Insulation (D 574 - 40 T).

NEW EMERGENCY ALTERNATE PROVISIONS

Specifications for:

- EA - A 268 Seamless and Welded Ferritic Stainless Steel Tubing for General Service (A 268 - 44 T).
- EA - A 269 Seamless and Welded Austenitic Stainless Steel Tubing for General Service (A 269 - 44 T).
- EA - A 270 Seamless and Welded Austenitic Stainless Steel Tubing for the Dairy and Food Industry (A 270 - 44 T).
- EA - A 271 Seamless Austenitic Chromium-Nickel Steel Still Tubes for Refinery Service (A 271 - 44 T).
- EA - D 754 Insulated Wire and Cable: Heat-Resisting Synthetic Rubber Compound (D 754 - 43 T).
- EA - D 755 Insulated Wire and Cable: Performance Synthetic Rubber Compound (D 755 - 44 T).
- EA - E 1 A.S.T.M. Thermometers (E 1 - 44).

Methods of:

- EA - D 470 Testing Rubber Insulated Wire and Cable (D 470 - 41).

Tests for Magnetic Properties:

In order further to bring its widely used Standard Methods of Test for Magnetic Properties of Iron and Steel (A 34 - 44) up to date, Committee A-6 has recommended revisions in several sections, one providing that if the original test fails to meet specification limits two additional specimens may be prepared, and if they pass, the lot is to be accepted. Also, the test specimen is to represent not more than 5000 kg. which is to constitute a test lot. These changes will be published in the back portion

(Continued on page 52)

Symposium on Magnetic Particle Testing

Sessions in Philadelphia, Monday, January 22

LEADING AUTHORITIES concerned with the use of magnetic particle testing and inspection methods will participate in a symposium on the subject being sponsored by the Philadelphia District Committee at the Benjamin Franklin Hotel, Philadelphia, on Monday, January 22. It is planned to have the papers and discussion presented in two sessions—afternoon and evening. As part of the meeting, the Philadelphia District Committee will hold an informal dinner, further details of which will be announced. A. O. Schaefer, Executive Metallurgical Engineer, The Midvale Co., has been directing development of the symposium for the district. Mr. Schaefer has taken a leading part in the development of Methods for Magnetic Particle Testing and Inspection of Heavy Forgings (A 275) which were promulgated in A.S.T.M. Committee A-1 on Steel during the summer.

The Philadelphia District Committee in its plans for a series of meetings throughout the year felt that this subject of magnetic particle inspection and testing was at a stage where a technical symposium would be very valuable, both from the standpoint of proponents of the test and those who are using it in so many different fields. During the past few years with the tremendously increased production of iron and steel products there has been much stress on inspection and quality control. Numerous nondestructive tests have been emphasized, for example, X-ray and gamma ray examination, and magnetic particle testing has increased tremendously. Many of the Army and Navy specifications require this and it has been widely used in the aircraft field.

Naturally, as in any system of testing, there has been a divergence of opinion, and the symposium will provide full opportunity for those who care to submit constructive comment to do so.

The basis of the symposium is a series of technical papers listed on this page. The abstracts of the papers which are given here will afford some idea of what the authors plan to cover. It is hoped to have reprints of this

Symposium on Magnetic Particle Testing

AFTERNOON SESSION—2 P.M.

Equipment for Magnetic Particle Inspection—A. V. de Forest and C. E. Betz, Chairman of Board of Directors and Vice-President, respectively, of Magnaflux Corp.

Magnetic Particle Inspection, Particularly from the Standpoint of Specification Requirements—H. H. Lester, Principal Physicist, Watertown Arsenal

Magnetic Particle Testing of Aircraft Materials—E. O. Dixon, Chief Metallurgical and Mechanical Engineer, Ladish Drop Forge Co.

The Magnetic Particle Test as Utilized by the Railroads—L. B. Jones, Engineer of Tests, Test Dept., The Pennsylvania Railroad Co.

EVENING SESSION—8 P.M.

Procedure and Specifications—A. P. Spooner, Metallurgical Engineer, Bethlehem Steel Co., Inc.

Magnetic Particle Inspection of Castings—C. L. Frear, Material Engineer, Bureau of Ships, U. S. Navy Dept.

Magnetic Particle Inspection of Forgings—C. J. Boyle, Works Laboratory, General Electric Co.

Special Applications of Magnetic Particle Testing—E. A. Snader, Laboratory Section Engineer, Westinghouse Electric and Manufacturing Co.

material available and a copy will be sent to any individuals who might be interested in presenting discussion.

HOTEL RESERVATIONS

Because of the crowded hotel situation in Philadelphia, members and others who will be attending the symposium are urged to send their requirements on hotel accommodations to the Benjamin Franklin Hotel, attention of Mr. C. L. Todd, Ninth and Chestnut Sts., Philadelphia, as soon as possible, mentioning their attendance at this A.S.T.M. symposium. The hotel expects to be able to provide sufficient sleeping room accommodations for those at the symposium, but needs to have advice as far in advance as possible. No special return reservation cards are being used.

ABSTRACTS OF PAPERS

Equipment for Magnetic Particle Inspection

By A. V. de Forest¹ and C. E. Betz²

MAGNETIC PARTICLE Inspection has found a useful place in nondestructive testing during the past fifteen years. Before that time the general principle had been described by Hoke in a patent issued in 1922. In 1929 two radical improvements were made by the introduction of circular magnetization and the use of magnetic particles specifically designed for inspection. First applied for locating quench and grinding cracks, and later

to finding fatigue cracks at overhaul, the method gradually spread to locating nonmetallic stringers and seams in bar stock and spring wire, and to welding, forging, and casting defects, in many cases supplementing or supplanting X-ray inspection even in heavy sections.

Equipment design has kept pace with advancing needs. The relative merits and limitations of alternating and direct current, half wave rectified a.c. and the use of a current surge, are well understood, but an intelligent choice of the right equipment, and, above all, a thorough educa-

¹ Chairman, Board of Directors, Magnaflux Corp. and Professor of Mechanical Engineering, Massachusetts Institute of Technology.

² Vice-President, Magnaflux Corp.

tion of the inspector, and his supervisor, are a prime requisite for success.

This type of test requires two steps: a magnetic field of proper direction character, and amount; and the application of the most suitable indicating particles to locate the leakage fields caused by discontinuities.

In order to meet these requirements to suit applications in various types of inspection, it is necessary to make the proper choice among a number of possible variables. As regards proper magnetization, the direction of the field depends on how the magnetizing force is applied. So-called circular fields are generated by passing current directly through the part being magnetized or through a conductor passing through openings in the part. Longitudinal fields are generated by coils or magnetic yokes. The intensity and distribution of the field are affected by the choice of magnetizing currents, direct currents producing fields penetrating deeply into the metal, whereas alternating currents produce fields concentrated in the surface layers.

Also affecting the sensitivity of the method is the sequence in which the steps of magnetizing and applying magnetic particles are carried out. In the most sensitive procedure often called the continuous method, the magnetizing force is maintained while particles are applied. In the residual method particles are applied after the part has been magnetized and the magnetizing force discontinued.

Choice of particles is another important consideration. Dry particles suitably selected for size, shape, and magnetic properties and colored to obtain contrast with the surface of the inspected articles are most sensitive for locating deep-seated defects especially in large articles.

Exceedingly fine magnetic oxides suspended in a liquid bath, usually of a light oil of high flashpoint, are very sensitive for fine surface discontinuities. This wet method is well adapted to production inspection of small, highly finished parts. Red and black colors are used for good contrast. A more recent method of increasing contrast is the use of oxide particles prepared with a fluorescent coating, inspection being carried out under near ultraviolet light.

Method of applying particles is also important as affecting the nature of and appearance of indications produced. Selection of the right technique and the right combination of these variables is of highest importance to successful inspection. Each field of application has requirements as to equipment and method peculiar to its

Discussion Invited

ONE OF THE chief objectives in connection with the Symposium on Magnetic Particle Testing is to stimulate comments and discussions on the methods and their applications in different industrial fields and on diverse products. Therefore, all those who are concerned with the matter are cordially invited to submit written discussion which should be sent to A.S.T.M. Headquarters or in lieu of this discuss the papers orally.

A. O. SCHAEFER

individual inspection problems, and experience has gradually developed suitable equipment and suitable procedures for various fields.

The field of manufacture of aircraft engine parts, as well as other aircraft and automotive parts, has favored use of the wet method, either residual or continuous, usually direct current. General purpose equipment is widely used, but many special purpose production type installations are in use.

Overhaul of aircraft and automotive equipment employs alternating current, residual, usually wet, but sometimes using the dry method. Direct current and wet continuous methods also have been extensively used. Equipment is mostly of the fixed general purpose type.

Railroad overhaul uses almost exclusively alternating current dry powder generally the continuous, but sometimes the residual method. Direct current and the wet method are also used in certain applications. Portable units are widely used in this field and also numerous special fixtures for handling parts.

Inspection of heavy forgings and castings generally calls for the dry continuous direct-current method, often requiring high current outputs. The prod method of local magnetization is also widely used. Portable equipment is frequently employed.

Inspection of welds and heavy weldments is done by prod magnetization using direct or half wave rectified current. Some use of alternating current to aid interpretation is also recommended. Portable units are generally employed.

Many other applications require various types of equipment, and in all fields specially built equipment finds considerable use in certain applications. In general, equipment properly engineered for the particular job should be used, and the use of magnets or yokes, welding generators or improvised equipment of any kind is to be discouraged, although any of these may under certain conditions and in the hands of experienced operators give very satisfactory results.

Magnetic Particle Inspection, Particularly from the Standpoint of Specification Requirements

By H. H. Lester¹

SURFACE DEFECTS

THE ORDNANCE Department uses magnetic particle testing methods to detect surface cracks or similar discontinuities. The method is appealing because it is simple, effective, highly sensitive, inexpensive, does not

involve complicated instrumentation, does not require a high order of technical skill, and lends itself to large-scale production. The disadvantage is that it may give undue prominence to minor defects. A check crack that would not be considered a defect may be brought out as sharply as a deeper crack that would be considered serious. This objection is rather important.

¹ Principal Physicist, Watertown Arsenal, Watertown 72, Mass.

Another ambiguity gives occasional trouble—this is in connection with undercuts at the edges of welds. There may be a crack beneath the undercut and this would be serious. The pattern for the crack would be masked by that of the undercut leading to the possibility of incorrect diagnosis, but the experienced operator should not be misled. Other disadvantages may be associated with the procedure. Where prods are used arcing may occur and cause hard spots that may give trouble in machining or may be the starting point of cracks that result in progressive failure. Also, materials of high magnetic retentivity tend to retain sufficient residual magnetism after the test to cause difficulties in subsequent machining.

In spite of the objections brought out above, the magnetic particle method is one of the best methods now available for the detection of surface defects in ferrous materials. But standards have not been set up illustrating typical patterns of acceptable and unacceptable conditions, except that the Navy does have standards illustrating patterns for laminations in rolled plate and other wrought materials. In these, typical patterns are shown in prepared sketches and acceptability conditions are defined in terms of the lengths of individual lines representing laminations, in the concentration of lines in a given region, and in the total extent of occurrence. Correlation of such defects with desired quality characteristics in the material such as physical properties or weldability is important. There is need for inspection criteria as clear-cut as the Navy ones for laminations to apply to surface defects in castings and weldments. They should enable the inspector to form a judgment as to the probable depth of indicated cracks and as to the probability of concomitant defects.

SUBSURFACE DEFECTS

One of the most important problems in nondestructive testing is in regard to detection of subsurface defects. Radiographic and other methods have been developed that are reliable but are open to the objection that they are expensive and time-consuming, and for these reasons do not lend themselves readily to large-scale production, particularly where a large percentage of the product must be examined. The magnetic particle test gives evidence as to subsurface conditions within certain limitations discussed below and has the advantages, pointed out in discussing surface defects, of simplicity, speed, low cost, and a lesser order of technical skill required in its application. With further development this method will no doubt become one of the most important methods for subsurface inspection of ferrous materials.

For this application the pattern obtained records variations in the magnetic field due to voids, inclusions, or crack-like discontinuities. Distinctive characteristics distinguish them from those due to surface defects. Many variables are involved in the formation of the powder pattern, such as: flux density, orientation, depth and dimensions of the defect, residual magnetism, magnetic powder characteristics, surface roughness, etc. The geometry of the piece is an important secondary factor affecting the uniformity of the magnetic field. In direct magnetization, the applied potential also affects the pat-

tern. Because of the variables, establishing pattern characteristics that are distinctive and that show depth below the surface is an extremely difficult problem. Some idea of its magnitude may be had from a consideration of the subsurface defects that must be identified. These include cracks, tears, unfused sections, incomplete penetration in welds, laminations in wrought materials, slag or sand inclusions, and voids in castings which may be gas cavities or pipes. Some of the above often do not yield distinguishable patterns, others yield patterns only when favorably oriented.

Difficulties in interpretation arise also because, in the present state of the art, a pattern description of a particular type of defect determined from one specimen might or might not be true for the same type of defect found in another specimen. An even more important objection is that different types of defect for the same test conditions give patterns that are not sufficiently distinguishable for inspection purposes. For example, many types of subsurface casting defects may all give diffused bands that could apply to any one of them. Regions of spongy metal due to piping or finely distributed gas cavities and diffused sand or slag give patterns that cannot be distinguished from each other with certainty. The same situation holds with regard to some defects in welds. In both castings and welds, there is the possibility of misinterpretation where masking occurs; that is, where the pattern for one defect coincides with that of another.

Even if distinctive patterns could be obtained, there is still the problem of estimating depth beneath the surface and in some cases depth dimensions of defects both of which may determine the rejectability of the piece. Patterns give reasonably reliable information as to whether the defect is on the surface or beneath it and whether the defect is diffused over a large area or concentrated. The inspector logically must reject if any subsurface indications are noted, the rejection necessitating further exploration by chipping. This causes rejection of much serviceable material and considerable delay in production which could be avoided if the inspection method could be improved.

In the foregoing paragraphs it has been the endeavor to assay the magnetic particle method as it applies to subsurface detection, to point out present shortcomings and to suggest fields in which further development is very much needed. In essence, there are required at the present time pictorial standards which will show: (a) unambiguous pattern characteristics distinctive of each type of defect, (b) pattern characteristics that will enable the inspector to estimate depth beneath surface, (c) pattern characteristics that will enable the inspector to estimate depth dimension. Questions of techniques to be employed have been avoided purposely. It is realized that procedures to accomplish the ends desired remain to be developed and that they may be impractical when they are developed. There are questions also as to whether magnetic powders are the best indicators. Possibly more sensitive methods of mapping the magnetic field would yield better results. At the present time satisfactory specification requirements cannot be worked out due to the lack of standards.

Magnetic Particle Inspection of Aircraft Parts

By E. O. Dixon¹

BRIEFLY COVERED are prevailing types of equipment and methods, while at greater length are treated the inspection and grading of steel for production of aircraft parts with reference to coordination of steel test results and final inspection rejection. Individuality of mill heats is in many cases pronounced and affords improved results through selected application of individual heats where operations permit sufficient latitude. Methods of fabrication often influence results of final inspection.

Prevailing practice in many plants is to subject parts to magnetic particles at various stages of fabrication to prevent avoidable effort on useless material. The amount

¹ Chief Metallurgical and Mechanical Engineer, Ladish Drop Forge Co., Cudahy, Wis.

and type of inspection may change from time to time because of varying conditions in material and processes. Methods and standards of inspection of finished aircraft parts should be, and in general are, based on the engineering significance of indications sought. Not widely recognized is the variation in magnetization in regular shapes, which in some cases results in a wide variation of the sensitivity of the inspection method.

The significance of indications commonly encountered is discussed with attention given to such common occurrences as: grinding checks, quench cracks, nonmetallic inclusions.

Discussed briefly are current trends in evaluation of various phases of the magnetic particle inspection methods in aircraft work generally.

The Magnetic Particle Test as Utilized by the Railroads

By L. B. Jones¹

ACCORDING to the best records obtainable, magnetic particle testing was introduced on the railroads to find detail fractures in locomotives and car axles. On the Pennsylvania Railroad the first beginnings came in 1933-1934. There seem to have been two reasons for making a beginning with axles. First, detail fractures in anything as important as an axle are always serious; and secondly, a dismantled axle presents the simplest shape for application of magnetic flux and powder particles. From the start on axles, the use of magnetic particle testing progressed rapidly in the railroad field, as the necessary technique was developed for handling more and more complicated shapes of iron and steel members. Testing outfits have been set up at the main locomotive and car shops, at principal engine terminals, and in wheel and axle shops. Men specially trained and qualified are assigned to the work, because the successful application of the test requires considerable experience; but where the necessary skill has been developed, tests can be carried on with both speed and accuracy.

The basic principles of successful testing are naturally the same in the railroad field as in other industrial applications, and need not be repeated here. They have already been ably defined by two A.S.T.M. subcommittees of our Committee A-1 in the new Tentative Methods of Magnetic Particle Testing of Heavy Steel Forgings (A 275) and Commercial Steel Castings (A 272).

The list of items subjected to magnetic inspection on the railroads reads almost like an index of locomotive and car parts. Wherever failures have been experienced, magnetic testing has been called in. Diesel engine parts have come in for attention, and also a variety of small tools, where the danger of spawling constitutes a safety hazard.

Testing technique varies, and it is interesting to note that satisfactory results are being obtained by a variety of procedures. Some use the familiar wire nail test to deter-

mine the proper flux density, and others depend on the appearance of the powder after application as a safeguard against too high flux values. Many railroads follow the general plan of passing a heavy current through parts where longitudinal cracks are suspected, and generating magnetic flux in an axial direction when transverse cracks are encountered. This flux may be generated by a few turns of cable with heavy current, using either alternating or direct current, or by coils having many turns with small current. The application of coils or cable are subject to many variations. Magnetism may be generated by a continuous flow of current, regulated to requirements, or a heavy "flash" current may be passed for a few seconds and the examination proceeds with the residual magnetism remaining in the piece, depending on the carbon content and surface hardness of the part under test. When the familiar "L" or "H"-shaped cracks associated with torsion fatigue are encountered, they may be brought out by magnetic flux generated in outside coils, to insure uniform flux distribution at the damaged section.

Cracks located in bends or corners can be detected by use of a "horseshoe" or "flatiron" magnet, which create a local flux through the particular area under suspicion.

For heavy currents, alternating current from a transformer or direct current from a welding set are both in use. For external coils having a number of turns, direct current finds the most general use. No difficulty is reported in obtaining a good pattern with the powder particles when using either alternating or direct current.

The wet and dry methods of applying testing powder are both in general use. Some prefer the dry method for rough surfaces, while, conversely, others claim best results with the wet method when the surface is rough. For irregular shapes, corners, or local explorations in close quarters, there seems to be general agreement that the dry method is most satisfactory. The wet method uses either carbon tetrachloride or turpentine substitute with satisfactory results as far as detection is concerned.

¹ Engineer of Tests, The Pennsylvania Railroad, Altoona, Pa.

Specifications and Procedures

By A. P. Spooner¹

THE PURPOSE of this paper is to make available some of the information which served as the background for those who formulated the A.S.T.M. procedures covering magnetic particle testing of steel castings and also large forgings.

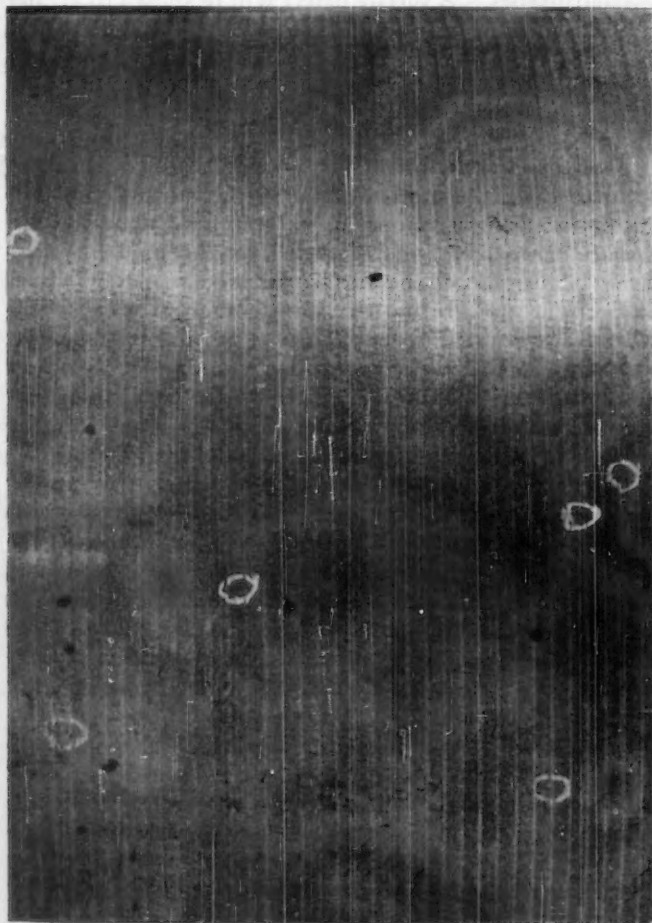
Magnetic particle testing has developed into a useful tool and is now being used extensively. Unfortunately, in general, the use of this test has preceded specifications covering the method of inspection and the acceptance or rejection of the parts.

Attention is called to the importance of the use of the proper magnetic field direction and strength. Examples are presented of field strength surveys of a few castings and forgings, demonstrating that even on a symmetrically shaped part, significant variations of magnetic field strength occur on the different surfaces.

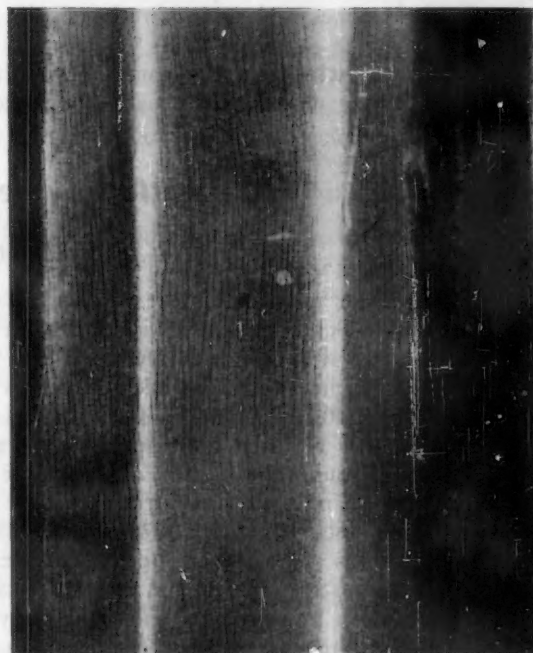
A type forging was selected showing some of the different magnetic particle patterns which are developed. The cause of the indications was explored. Even though there is similarity among the particle patterns, their causes may be widely divergent.

The inspection history of a forging is cited. This

¹ Metallurgical Engineer, Bethlehem Steel Co., Bethlehem, Pa.



What is the history of this forging?

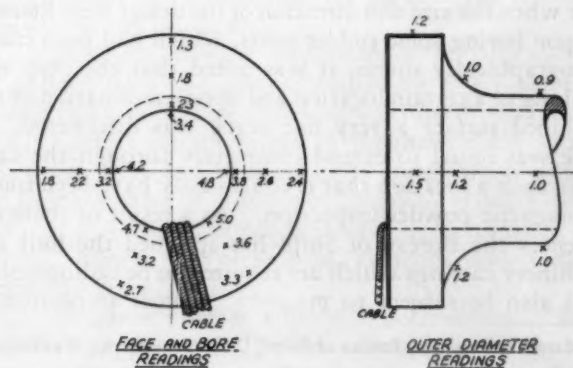


What caused these indications and can other conditions cause similar appearing indications?

demonstrates the need for proper and uniform methods of magnetization and the necessity of correct interpretation and thorough understanding of what the developed indications represent and their seriousness.

The usefulness of magnetic particle testing depends to a great extent on the wholehearted cooperation between producer and consumer. How valuable this method may become when properly used and interpreted through mutual understanding is illustrated in inspection surveys of millions of similar parts.

Magnetic particle inspection is not any part of steel-making practice, but is a very searching inspection method. The consumer, merely by specifying magnetic



How uniformly is this forging magnetized?

tion, is by no means insured against parts subjected to this test, may not show indications. This brings out the point that the consumer must advise the steel maker what he considers injurious. It is that judgment and experience must be used. It is essential that all concerned be kept fully advised of the requirements at all times and maintain the closest cooperation.

While magnetic particle inspection sometimes replaces older and less searching methods, it usually supplements

them. It presents new and previously unrecognized problems. It demands most careful consideration for proper interpretation. Understanding and cooperation between consumer and producer are primary requisites.

This presentation attempts to give a clearer insight to the reason for including in the A.S.T.M. procedures the restrictions that a thorough agreement between consumer and producer is necessary when magnetic particle inspection is to be used.

Magnetic Powder Inspection of Castings

By Clyde L. Frear¹

ALTHOUGH RADIOGRAPHIC examination was required by the Navy Department as early as 1930 in the inspection of seams in welded boiler drums, it was not until 1936, at which time gamma-ray technique was developed by the Naval Research Laboratory, that radiographic inspection was required on cast materials produced by Navy Yard foundries. Later, radiographic inspection was specified in contracts for important and highly stressed hull castings. Since 1939, specifications require that all castings subjected to superheated steam, all castings in the main steam system and all hull castings directly concerned with maneuvering the vessel may be subjected to radiographic inspection. Although radiographic inspection has not been completely effective in preventing service failures, such failures have fallen to a very small percentage of those experienced prior to specifying this method of nondestructive inspection.

While magnetic powder inspection has been used for some time in testing forgings, and to a small extent in inspecting ordnance castings regularly subject to high shock in service, this method of inspection has not generally been specified for ship castings. It was noticed, however, that occasionally valves and fittings which had successfully passed all radiographic inspection and hydrostatic tests at twice the service pressures developed leaks through flanges. Upon subjecting the casting to magnetic inspection a discontinuity was noted having the form of a hot tear or a crack running circumferentially around the bore immediately under the flange. Further magnetic inspection showed that approximately thirty per cent of all flanges produced contained this hot tear defect which in most cases was invisible to the eye, and which could not be indicated by radiographic inspection even when the size and direction of the defect were known.

Upon boring some rudder posts, which had been found radiographically sound, it was noted that the chip was breaking in a certain location and upon examination of the machined surface a very fine crack was discovered. A crack was found to extend completely through the casting in such a location that it could easily have been found by magnetic powder inspection. As a result of these experiences the Bureau of Ships has specified the hull and machinery castings which are required to be radiographed shall also be subject to magnetic powder inspection in

those locations which are highly stressed in service and in those locations where defects have previously been found but which were not detected by radiographic means.

MAGNETIC POWDER INSPECTION

Magnetic powder inspection consists in magnetizing the part to be tested by direct application of electromagnets, by inducing a magnetic field in the part itself by the passage of an electric current through the part, or by placing the part in a magnetic field. Where any discontinuity is present there is a leakage of the adjacent magnetic lines of force through the surrounding metal and the air. Magnetic powder will arrange itself along these magnetic lines of force and will tend to "pile up" at the discontinuities. A surface defect will be shown to greater advantage than will a subsurface defect. As the defect becomes more deep seated, powder indication will become less evident.

CASTING DEFECTS

Sand and Slag Inclusions: Anything which will permit sand to enter the molten metal in the mold cavity will result in sand inclusions unless this sand floats on the surface of the metal and is carried out through the risers. Sand inclusions on the surface may be found by visual inspection; just below the surface they may cause sufficient flux leakage to be identified by magnetic powder inspection. Deep-lying inclusions would probably not be recognized as such by magnetic inspection. Slag entrapped in the metal may be found in almost any location and give magnetic indications similar to sand inclusions.

Gas Porosity: Cavities due to gas porosity may appear in several forms, usually more numerous in the cope portion of the casting than in the drag. Gas porosity consists usually of a number of almost perfectly rounded and sharply defined cavities usually occurring near the surface, but may extend throughout the casting section. No special difficulty should be experienced in locating by magnetic powder inspection gas porosity which lies sufficiently near the surface.

Hot Tears: A true hot tear is caused by resistance to free shrinkage of the casting at a time when the metal has just solidified and has little or no strength or ductility. Resistance to shrinkage may be caused by anything which tends to resist free movement of the cooling casting. Although hot tears are often difficult to find by visual inspection, it is probable that all of them reach the surface at some point, and are therefore capable of being

¹ Materials Engineer, Bureau of Ships, U. S. Navy Dept., Washington, D. C.

The opinions expressed herein are those of the writer and not necessarily those of the Bureau of Ships or the Navy Department.

easily found by magnetic inspection although the defects themselves may not be visible to the eye.

Cracks: Cracks form at a temperature considerably below that at which hot tears occur and probably result from stresses set up in the casting when it is in the brittle range and are formed when the casting is cold or slightly below the tearing temperature. Cracks, being surface defects, are easily identified by magnetic inspection but may be missed entirely by radiography.

Shrinkage: Shrinkage is an internal defect usually limited to the heavier sections which are the last to solidify. Shrinkage cavities may be smooth walled or extremely ragged and sometimes appear similar to hot tears radiating almost to the surface. Massive shrinkage is a deep-seated defect difficult to detect by magnetic inspection except where accompanying tears or cracks approach the surface. Correct interpretation of the magnetic indication may be difficult or impossible.

Chaplets and Internal Chills: Although chaplets can usually be avoided, they are sometimes necessary and when the mold is poured some points may exist which are unfused thus increasing the tendency to leakage under high pressure. The same is true of internal chills. Because of the difficulty which has been experienced in the past due to leakage around unfused chaplets and chills Navy specifications require that all such be radiographed. It has been shown that unfused chaplets are indicated by magnetic inspection but chaplets and chills are usually of lower carbon content than the surrounding metal and may give magnetic powder indications even though complete fusion exists. Some foundries making castings drill out all chaplets and chills and weld up the cavity rather than depend upon either radiography or magnetic inspection to locate unfused areas.

MAGNETIC POWDER PROCEDURE

Prod Method: In general the procedure for magnetic powder inspection consists of passing an electric current through the part in a direction roughly parallel to the defect. The prod method is used in the majority of cases for medium and large castings. Copper or other suitable rods pressed by hand into contact with the part to be tested permit a continuous flow of current which is continued while magnetic powder is dusted on the area between the prods. Where a defect or discontinuity which will cause magnetic flux leakage is present, the powder will build up at this point indicating the exact point of leakage. At or near the surface, the indication will be sharp. As the depth of the defect under the surface increases the indication becomes progressively more diffuse and ultimately disappears altogether.

Ordinarily a current of 300 to 500 amperes with a prod spacing of six to eight inches is sufficient to produce satisfactory indications of defects located within $\frac{3}{8}$ in. of the surface. For complete coverage, it is necessary to explore the entire surface with the current flowing in one direction then re-explore with the current passing approximately at right angles to the original direction.

All-Over Method: The "all-over" method consists in clamping the electrodes at the extremities of the casting and passing the magnetizing current throughout the area between the connections. A much higher current is required than with the prod method to obtain the neces-

sary magnetizing force. Current tends to fan out through the casting, and this method provides much more rapid testing than does the prod method.

Wrap-Around Method: When magnetically testing long cylindrical castings, it is often advantageous to place several turns of the leads around the piece and pass the current through the coils thus formed. As in the all over method, a flux density meter should be used to determine the number of ampere turns required to provide the most efficient magnetizing force. This method indicates to the best advantage circumferential defects.

MAGNETIZING EQUIPMENT

The chief requirement for magnetic powder inspection is equipment which will supply current for sufficient amperage at as low voltage as practicable. Welding generators when used with certain precautions will produce the required current for magnetic powder inspection with the prod method. When using welding machines as the source of current a contactor switch should be provided to break the circuit before removing the prods as arcing may cause surface cracking or produce hard spots. Storage batteries also may provide a readily portable source of current. With the low voltage (2 volts) there is no danger of harmful arcing.

INTERPRETATION OF RESULTS

Probably one of the greatest restraints to the general acceptance of magnetic powder inspection of castings has been the fear on the part of the manufacturers that the persons interpreting the magnetic powder indications would not be sufficiently experienced to distinguish between harmful defects and indications resulting from incorrect magnetizing technique or slight surface defects not affecting serviceability. The Bureau of Ships has limited the use of magnetic powder inspection to the location of surface hot tears and cracks. In castings where small tears or cracks are permitted the acceptability of such defects is judged with regard to size, extent, and direction by comparison with the Bureau Radiographic Standards.

MAGNETIC POWDER VERSUS RADIOGRAPHIC INSPECTION

The Bureau of Ships has interpreted an exceptionally large number of radiographs from castings of various types and sizes comparing the defects found with magnetic powder indications, also observing the effects of such defects on the serviceability of the parts. The following conclusions can be drawn:

(a) Magnetic powder inspection is specially suitable for surface tears and cracks, which are easily identified as such and is preferable to radiography for most cracks.

(b) Correct interpretation of internal defects such as gas, sand, slag, and in most cases shrinkage is difficult and in many cases impossible by magnetic powder inspection, but it is easy to determine by radiography when such internal defects are present in amounts which might present a service liability.

(c) Magnetic powder inspection is considerably faster than radiographic examination. By subjecting the casting to magnetic powder inspection and removing the defects before radiographing, the actual time and manhours

required for inspection and repair have been materially reduced.

(d) Magnetic powder inspection and radiography

supplement each other in the inspection of castings. Neither one by itself will show conclusively the presence of harmful defects in all areas.

Magnetic Particle Inspection of Forgings

By Clarence J. Boyle¹

THIS PAPER describes an investigation made to determine some basic information regarding the different methods of magnetization, field intensity, and sensitivity of powders and pastes, in connection with the inspection of large forgings.

The investigation was confined to surface defects only, such as forging folds and laps, thermal cracks that extend to the surface, and inclusions.

Several forgings of different sizes known to contain thermal cracks were used for tests. These forgings were thoroughly demagnetized between each series of tests. The results were recorded by Scotch tape pictures, some of which are shown. Figure 1 shows one of the partially machined rotor forgings that was used. This rotor has a maximum diameter of $44\frac{1}{4}$ in. and is slightly over 8 ft. long. Figure 2 shows the Scotch tape record of thermal cracks found in the test forging at different diameters.

¹ Works Laboratory, General Electric Co., Schenectady, N. Y.

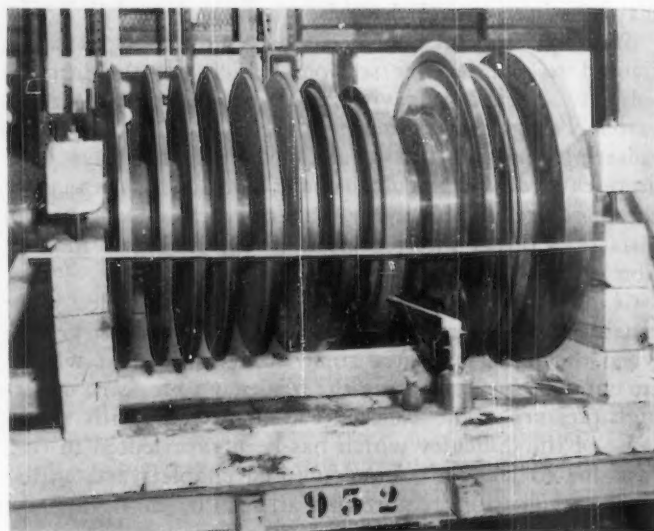


Fig. 1—Partially Machined Rotor Forging

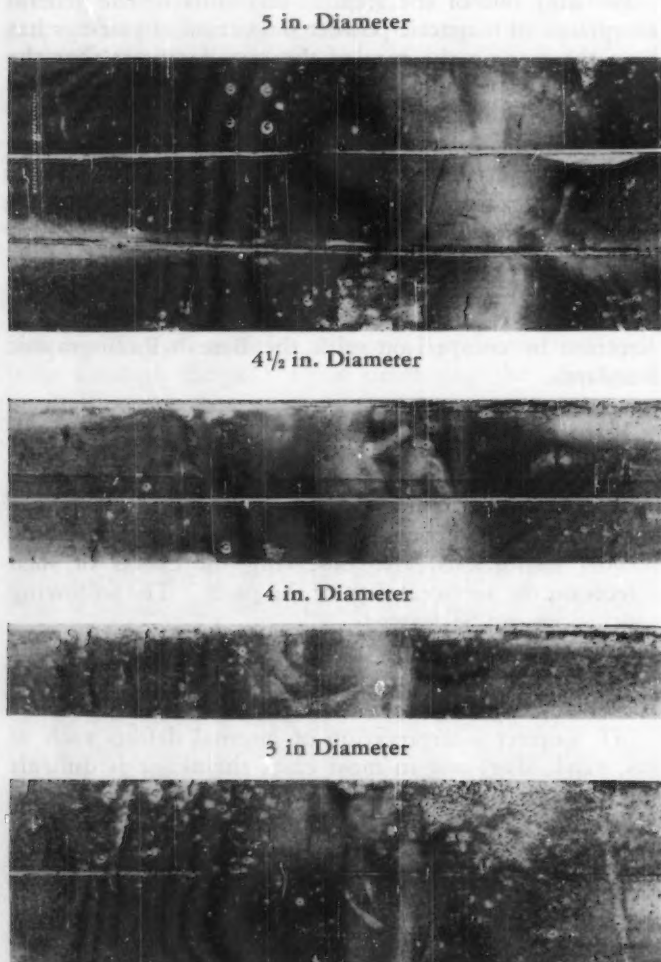


Fig. 2—Magnetic Particle Patterns

Oscillograms are shown to illustrate the magnitude of the ripple or pulsations obtained from a.c., commutated d.c., and d.c. rectified from 3-phase a.c. Some claims are made that these ripples impart greater mobility to dry powder, thus making it more sensitive in the location of defects. We can find no evidence of this and we believe that d.c., whether obtained from generators, rectifiers, or storage batteries, will give equivalent results.

Figure 4 is one of the many test record sheets that were obtained from the series of investigations. It will be noted there is no record under the a.c. test at 600 amperes because no patterns of any kind were obtained, and under 800 amperes a.c., the patterns obtained were unsatisfactory. In all cases the d.c. wet method gave satisfactory patterns.

Other cases are covered which show better results from d.c. than with a.c. However there was one situation where the defect was brought out by all powders and methods, using circular magnetism, but where the use of d.c. electromagnets failed to reveal any trace of the defect.

A comparison of the data secured indicates the following general conclusions:

1. Circular magnetism is the more effective method.
2. Circular magnetization with direct-current obtained from generators, copper oxide rectifiers, or storage batteries, gives equivalent results.
3. D.c. is more effective than a.c.
4. D-c. continuous method is the most sensitive and the most definite for revealing surface defects.
5. D-c. residual method is slightly less effective than the d-c. continuous method.
6. D-c. surge method is between the d-c. continuous and d-c. residual method in effectiveness.

7. Electromagnets may be used in some cases, but they are not as effective or efficient as circular magnetization.
8. The wet method is more sensitive than the dry method.

A typical magnetization and permeability curve for a general run of alloy forging steel shows that the region of maximum permeability at which region the test should be made, begins at an induction of approximately 8500 gauss, or at about 40 per cent of the saturation induction value of the material.

It was found that 1600 amperes d.c. gave satisfactory indications, and 2000 amperes was sufficient for best results.

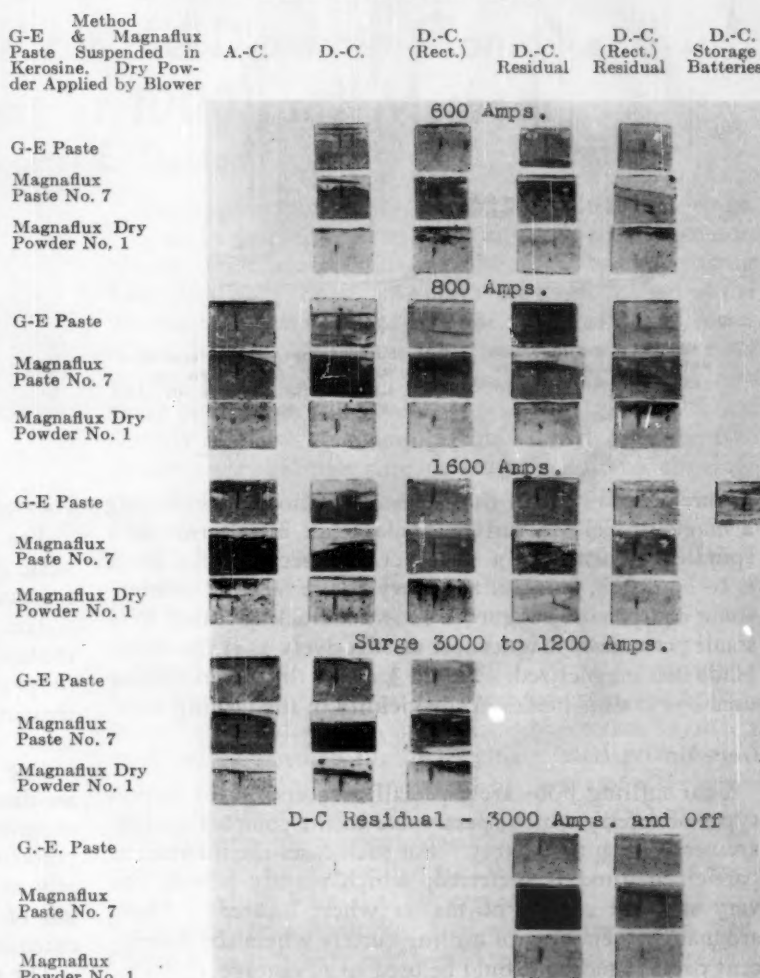
Figure 10 in the paper shows constant direct-current plotted with the diameter of forging for different constant flux densities (gausses) at surface. This shows that to maintain a flux density of $B = 8500$ gauss at the surface, requires a current of about 75 amperes per inch diameter.

For round forgings, the ampere per inch rule can be applied with reasonable assurance of a successful test. However, for irregular shaped forgings, an instrument was developed which gives a direct indication of the field strength and allows standardized testing at a specified value, so that the same size defects give similar indications.

In the recent 18-month period we have made magnetic particle tests on 3092 forgings, ranging in weight from a few hundred pounds to 150,000 pounds. Of this number, 130, or 4.2 per cent, were rejected for defects revealed by magnetic particle testing. Unfortunately, most of the defects were so located that they could not be detected until after final machining. This limitation of magnetic particle testing resulted in a loss of manhours and machining operations that were, in most cases, of greater value than the forging itself.

Magnetic Particle Patterns

Turbine Rotor Alloy Steel Forging.



Results of experimental tests with supersonics are very promising, but much development work has yet to be done before this method will be practical for production work.

Miscellaneous Applications of the Magnetic Particle Test

By E. A. Snader¹

THERE are many very important applications of the magnetic particle test that are not covered in detail by the papers of this symposium. However, there is no question but that the greatest use of this test is made by the aircraft industry, where the necessity for the very minimum of weight of highly stressed parts makes it essential that even the most minute flaws be detected. There can be little doubt that a good share of the credit for the remarkable performance of American aircraft should go to the magnetic particle test.

Turbine Blades:

One of the first and most important applications of the test was in the testing of turbine blades. These blades are frequently subjected to very high and complex stresses

¹ Laboratory Section Engineer, Westinghouse Electric and Mfg. Co., Philadelphia, Pa.

and it is essential that any material or manufacturing flaws be found. In the testing of the blades as a final inspection before installation, the wet method is used since some of the defects encountered can only be detected by the extreme sensitivity of this method. Blades are frequently tested after a period of operation in the turbine to detect the presence of any fatigue cracks that may have started. For this purpose the dry method is generally preferred because the fatigue crack results in such interruption of the magnetic field that the extreme sensitivity of the wet method is not required. In addition, the increased visibility of the greater build-up of the dry powder, especially when lighting is not the best, greatly assists in inspection. Also, the presence of scale or other coatings detracts from the effectiveness of the wet method to a far greater degree than when the dry powder is used.

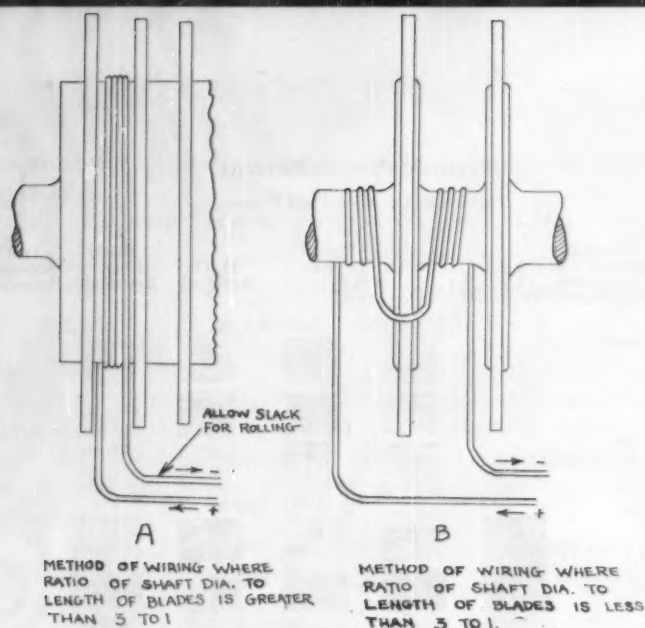


Fig. 1

Figure 1 shows one of the preferred methods of producing a magnetic field in turbine blades after installation in a spindle. When only a small, critical section of a blade is to be tested, it is not necessary to use large or cumbersome equipment. Figure 2 shows a crack revealed by a small permanent magnet just as effectively as if the entire blade was magnetized. Figure 3 shows this magnet being used to examine blades in the vicinity of the lashing wire.

Gear Milling Hobs:

Gear milling hobs are especially susceptible to certain types of defects which, partly due to the complex design, are very difficult to detect. For such cases the fluorescent particle method is preferred, which readily reveals the very smallest cracks, no matter where located. There are many other types of milling cutters where the fluorescent particle method could be used to advantage.

Pinion Teeth:

In all cases of magnetic particle testing the magnetic field must be properly applied. However, this is especially true in the case of forged steel pinion teeth. Such methods as winding a welding cable around the shaft or the use of yokes are unsatisfactory because the surface contour tends to prevent a satisfactory field in the teeth. Small electromagnets that span about four inches give good results, but the method is laborious. A strong circumferential field, obtained by passing sufficient current directly through the pinion, has proved a very satisfactory method.

Bolts and Studs; Plates:

The threaded section of bolts and studs can be tested for cracks in the roots of thread, provided again that a circular field is used. This is another case where the fluorescent particle method is a great advantage since it is frequently very difficult to see the ordinary indications, even when present. The solenoid method of testing large threaded studs has not proved satisfactory for the detection of cracks in the roots of the threads.

There are many parts made of heavy steel plate where excessive laminations may be very harmful. These laminations are readily revealed whenever they are present along the edges of the plate. Fire cracking and stress corrosion cracking of boiler plates can also be detected in time to prevent serious consequences.

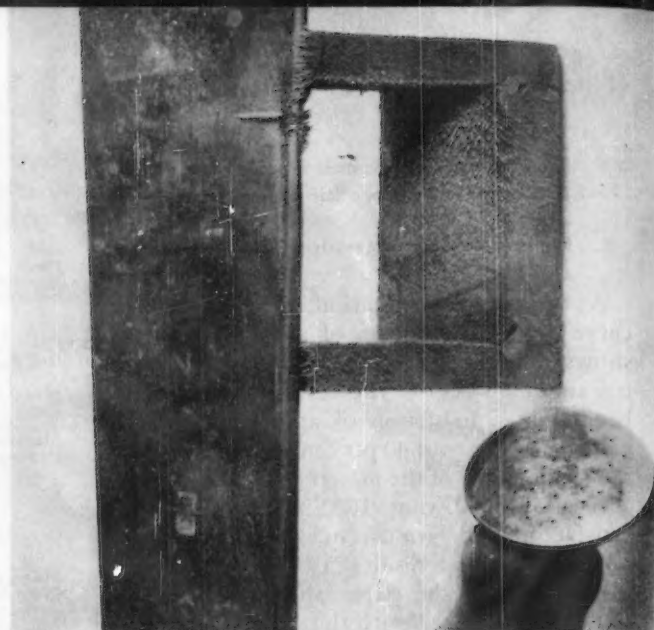


Fig. 2

Automotive; Tools; Weldments:

The entire automotive industry makes use of the magnetic particle test in the constant effort to improve performance and reduce failures.

The magnetic particle testing of tools is such a tremendously large field that it can really only be mentioned in passing. Many improvements in tool design, heat treating and grinding methods are the direct result of this test.

One of the very large fields for the test is the testing of weldments. In this field, however, the greatest skill is often required both in making the test and in the interpretations. Although the limitations of the test, especially in regard to sub-surface defects, are recognized, the use of magnetic particle testing of weldments is being extended almost daily.

The increasing use of the magnetic particle test is probably the best evidence of its value. New specifications requiring the test are constantly being written. The most recent test methods are probably the tentative standards covering the magnetic particle testing of large forgings (A 275) and castings (A 272) prepared by subcommittees of A.S.T.M. Committee A-1 on Steel. Not only are the larger industries expanding their use of the test, but it is also being adopted by the more progressive machine and welding shops.



Fig. 3

Tests Comparing the Modulus of Elasticity of Portland Cement Concrete as Determined by the Dynamic (Sonic) and Compression (Secant at 1000 psi.) Methods¹

By Thomas E. Stanton²

THIS DISCUSSION relates to tests designed primarily to compare modulus of elasticity determinations by the dynamic and compression methods.

In series I the dynamic modulus of elasticity tests were made on both 6 by 6 by 34-in. beams and 6 by 12-in. cylinders, whereas, the compression (secant) modulus of elasticity determinations at 1000 psi. were made on the cylinders only.

There was a close correlation at all ages (4 days to 1 yr.) between the dynamic modulus determinations on both beams and cylinders, but the secant modulus averaged somewhat less than the dynamic.

Series II and III relate to subsequent tests designed to check certain determinations of the first series, particularly the effect on the modulus of elasticity at later ages on specimens upon which stress-strain determinations had been made at earlier ages.

SERIES I

As stated, the primary purpose of the tests described in this report was to determine the relation, if any, between the modulus of elasticity by the dynamic (sonic) and compression methods.

As far as possible, all factors related to mix and fabrication were kept constant. Thus in the first series all test specimens (eighteen 6 by 12-in. cylinders and eighteen 6 by 6 by 34-in. beams) were fabricated from the same batch of concrete mixed in the field in a standard paving mixer during regular paving operations. The water-cement ratio and slump were therefore constant, as well as the cement and aggregates.

The secant modulus at 1000 psi. was determined on all unbroken specimens at each test period from 28 days on, and up to 2000 psi. at 3 months, 6 months, and 1 yr. The load applications were continuous and there was immediate release as soon as the maximum load at which the stress-strain measurements were taken was reached. There was, therefore, little time for plastic flow.

The extensometer used to measure the compression deformation of the concrete resembled very closely that described by Stanton Walker in his paper presented before the Society in 1919.³ The main difference was that the California extensometer, which was built by the late Val Arntzen of the University of California Engineering Materials Laboratory, has circular band yokes instead of the rectangular yokes used by Walker.

The apparatus consists of two cast aluminum rings, 6½ in. in inside diameter, 8½ in. in outside diameter, 5⅝ in. thick, spaced 8 in. apart by means of two spacing bars (Fig. 1). These two bars are removed after the instrument is attached to the test specimen. The lower ring is held rigidly to the concrete cylinder by three set screws, 120 deg. apart. The upper ring is held by two sharp pointed set screws, 180 deg. apart. A distance rod directly opposite an Ames dial and at 90 deg. to the two set screws in the upper ring maintains one side of the rings in a fixed relation to each other. The distance rod is attached rigidly to the lower ring and fits in a ball-and-socket joint in the upper ring. A strong spring holds this rod in position. This arrangement causes the top ring to rotate about its point of contact as the specimen is compressed.

The Ames dial, reading to 0.001 in., is attached rigidly to the upper ring. Twice the total deformation is transmitted to the dial, the stem of which presses against a steel rod fastened to the lower ring. The vertical position of this rod may be adjusted by means of a set screw under the lower ring.

In making the dynamic modulus determinations, the correction factor *T* described by Obert and Duvall in their paper published by the Society in 1941⁴ was applied; correction curve 4 of Fig. 1 of their paper being used. Curve 4, which applies directly to prisms, was used for the 6 by 12-in. cylinders by entering the chart at an abscissa value which is $\sqrt{3}/2$ times the ratio of diameter to length. For example, for ratio of diameter to length of cylinder of 0.5, enter the chart at an abscissa value of 0.433.

In making the dynamic frequency determinations, equipment similar to that described by Obert and Duvall was used.

Figure 2 of this paper shows how closely the dynamic modulus determinations on the cylinders agreed with similar determinations on the beams.

Dynamic and compression modulus determination were likewise made at 28 days on specimens fabricated throughout the life of the project on which the 18 cylinders and 18 beams were fabricated for this special test series.

Forty-eight cylinders and beams fabricated during the entire job gave the following results at 28 days:

Dynamic modulus (6 by 12-in. cylinders).....	4 800 000 psi.
Dynamic modulus (6 by 6 by 34-in. beams).....	4 900 000 psi.
Secant modulus at 1000 psi. (cylinders).....	3 000 000 = 62 per cent dynamic modulus
Compressive strength (cylinders).....	3870 psi.
Compressive strength (cores).....	4240 psi.
5.00 sacks of cement per cubic yard.	

NOTE—DISCUSSION OF THIS PAPER IS INVITED, either for publication or for the attention of the author. Address all communications to A.S.T.M. Headquarters, 260 S. Broad St., Philadelphia 2, Pa.

¹ Presented at the Forty-seventh Annual Meeting, Am. Soc. Testing Mats., New York, N. Y., June 26-30, 1944.

² Materials and Research Engineer, California Division of Highways, Sacramento, Calif.

³ Stanton Walker, "Modulus of Elasticity of Concrete," *Proceedings, Am. Soc. Testing Mats.*, Vol. 19, Part II, p. 510 (1919).

⁴ Leonard Obert and Wilbur I. Duvall, "Discussion of Dynamic Methods of Testing Concrete with Suggestions for Standardization," *Proceedings, Am. Soc. Testing Mats.*, Vol. 41, p. 1053 (1941).

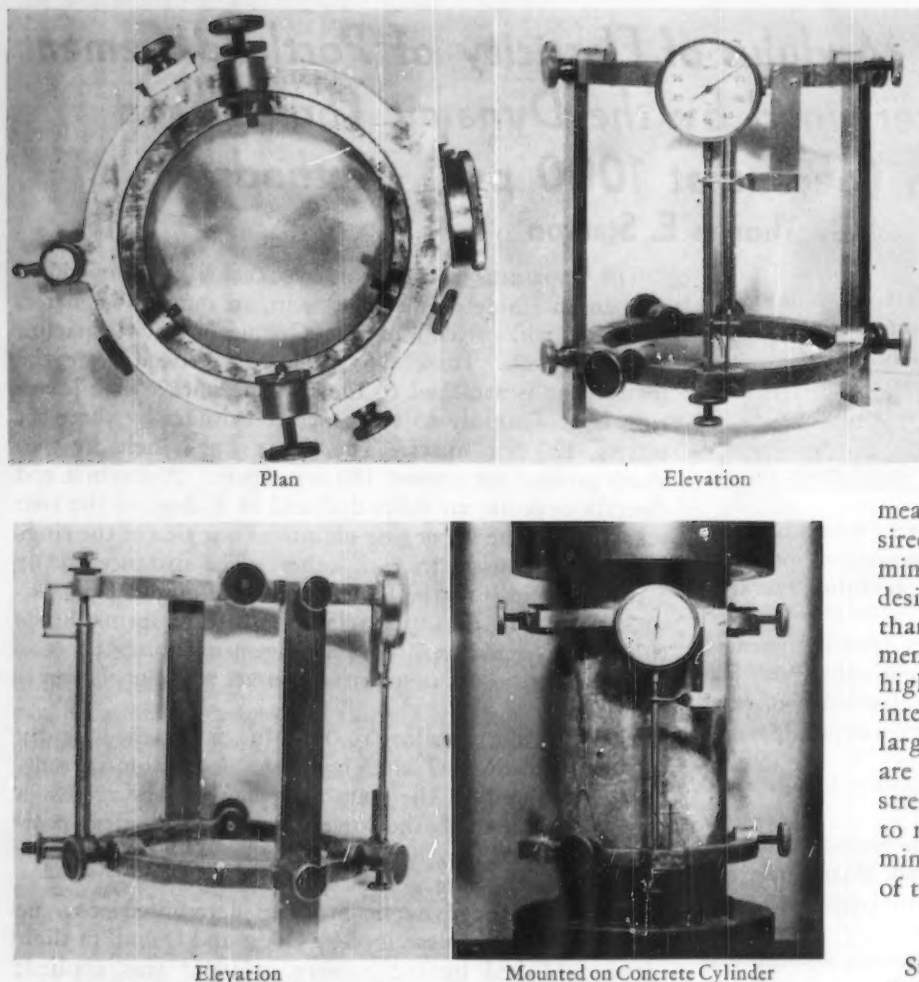


Fig. 1.—Extensometer for Determining Modulus of Elasticity of Concrete.

It is of interest to note the close agreement of all dynamic and compressive modulus determinations on these routine job specimens with similar determinations on the eighteen cylinder specimens from the single batch from which the special set of test specimens was fabricated (Table I).

As will be noted, the concrete on this project, which contained 5 sacks of cement per cubic yard, did not develop particularly high compressive strength at 28 days, but by 3 months well exceeded 5000 psi. and by 1 yr. substantially exceeded 6000 psi. The pavement core strength (cores cut just prior to test) were as follows:

51 cores at 28 days averaged 4240 psi. in compression

48 cores at 2 yr. averaged 7135 psi. in compression

No cores were tested at 1 yr. and there were no cylinders available for test at 2 yr.

Relation Between Dynamic and Secant Modulus:

Powers,⁵ by averaging the stress-strain measurements on opposite sides of 6 by 12-in. cylinders obtained initial tangent modulus values which checked fairly close with the dynamic modulus determinations made on companion 5 by 5 by 18-in. bars. At the same time, Powers shows a somewhat lower secant modulus at 1000 psi. than the dynamic modulus of an unloaded specimen. The results of

⁵ T. C. Powers, "Measuring Young's Modulus of Elasticity by Means of Sonic Vibrations," *Proceedings, Am. Soc. Testing Mats.*, Vol. 38, Part II, p. 460 (1938).

the tests described in this paper appear to check Powers' determinations.

Under the conditions of test described, the secant modulus of the cylinders at 1000 psi. was found to range from 62 per cent of the dynamic modulus at 28 days to approximately 75 per cent at later periods. It was apparently possible to measure the dynamic modulus of the 6 by 12-in. cylinders as accurately as of the 6 by 6 by 34-in. beams, although the frequency of the cylinders was of such an order as to be at or close to the

measurable limit. Therefore, if it is desired to make dynamic modulus determinations on cylindrical specimens, it is desirable that either the length be greater than twice the diameter, or that equipment with adequate sensitivity in the high-frequency range be used. It is of interest to note, however, that where large numbers of 6 by 12-in. cylinders are fabricated for routine compressive strength tests, it is apparently practicable to make accurate dynamic modulus determinations on specimens where the ratio of the diameter to length is 0.5.

SERIES II

Subsequent to the initiation of the tests described under series I, a question was

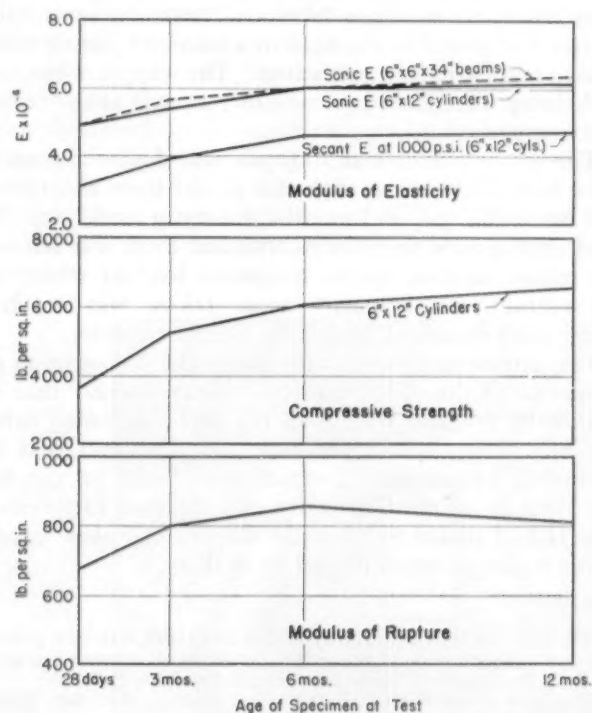


Fig. 2.—Comparison of Compressive Strength, Modulus of Rupture, and Modulus of Elasticity (Compressive and Sonic) Tests on Concrete from a Concrete Paving Project in Ventura County, Calif.

TABLE I.—COMPARISON OF COMPRESSION, MODULUS OF RUPTURE AND MODULUS OF ELASTICITY TESTS ON 36 FIELD SPECIMENS OF CONCRETE FROM AN EXPERIMENTAL PAVING PROJECT IN VENTURA COUNTY, CALIF.
5 sack Concrete. All figures are the average of tests on three specimens. Cylinders 6 by 12 in. Beams 6 by 6 by 34 in.

	Compressive Strength, psi.		Modulus of Rupture, psi.	Modulus of Elasticity, E , psi. $\times 10^{-4}$			Secant Modulus Dynamic Modulus 6 by 12-in. Cylinders
	Cylinders	Beam Ends		Dynamic		Compressive Cylinders at 1000 psi.	
				Beams	Cylinders		
4 days	1210	2140	333	3.47	3.46	1.19	0.34
10 days	2050	3320	588	4.29	4.47	2.31	0.52
28 days	3610	5120	678	4.92	4.90	3.06	0.62
3 months	5210	6670	797	5.61	5.38	3.89	0.72
6 months	6010	6390	859	6.00	6.03	4.58	0.76
1 yr.	6570	7280	808	6.36	6.21	4.66	0.75

NOTE: Dynamic determinations were made by measuring the fundamental frequency using T correction curve 4, Fig. 1, and the same type equipment shown in Fig. 2 of Obert and Duvall's paper.

raised as to the accuracy of determinations made at subsequent periods on specimens which had been previously stressed at earlier test periods.

Because of the fact that plastic flow of concrete takes place under sustained compression and that under such conditions there is a change in the modulus of elasticity, it was contended that even under the conditions of the test described in this paper where the load was released immediately after reaching 1000 or 2000 psi. there would be sufficient alteration of the structure of the specimen to effect the results at later ages as compared with tests on specimens which had not previously been stressed.

As a search of the technical literature failed to disclose any information on the subject it was decided to run a second series in which the tests at successive ages would be made on specimens some of which had been stressed and some unstressed at the earlier ages.

The 3-month results of this second series are now available. A brief summary is presented in Table II.

The figures for group 1, Table II, are the dynamic and secant modulus determinations at the different ages on specimens not previously stressed.

It will be noted that on the average the group 1 results do not differ materially from the tests on the previously stressed specimens in groups 2 and 3, although, whenever the specimens were stressed beyond an appreciable percentage of the ultimate compressive strength, there was some, though comparatively slight, falling off in the secant modulus.

Thus, the secant modulus for the 14-day specimens in group 2 which were stressed three times to 1000 psi. before breaking in compression fell off from 3,900,000 psi. on the first compression to 3,700,000 psi. on the third compression. During the same cycle of operations the dynamic modulus fell from 5,500,000 psi. to 5,200,000 psi. The compressive strength at 14 days was only 2280 psi.

At the same time the specimens in group 2 which were not stressed at 14 days but held until 28 days by which time the compressive strength had increased to 3360 psi. showed no drop in compression modulus and little, if any, in dynamic modulus under repeated compressions to 1000 psi. at 28 days and no drop at all in either compression or dynamic modulus at 90 days after three compressions to 1000 psi. at which time the ultimate compressive strength had reached 4650 psi.

In group 3, where the specimens were stressed three times to 2000 psi. at 28 and 90 days, there was some falling

off under three repetitions of the load, the reduction being greater at 28 days than at 90 days.

As authorities appear agreed that when plastic flow takes place under a sustained load the modulus of elasticity increases, it would appear that in the tests herein described, where the modulus of elasticity values dropped when the specimen was overstressed with relation to its ultimate strength, there was some slight rupture in the specimen rather than alteration due to plastic flow.

It further appears conclusive that when the concrete reaches a compressive strength in excess of 3000 psi. and has not previously been stressed the modulus of elasticity at subsequent ages is not appreciably, if any, affected provided the loading is continuous to 1000 psi. and released the instant that load is reached.

The above conclusions are based on tests on a number of specimens, none of which showed any appreciable difference in the modulus of elasticity of concrete by the dynamic (sonic) and compression methods with particular reference to the effect of repeated compressions of the test specimens to 1000 or 2000 psi. at intermediate test periods as well as just prior to test for compressive strength.

	Weight, lb. per cu. ft.	Com- pressive Strength, psi.	Dynamic Modulus, psi. $\times 10^{-4}$		Secant Modulus at 1000 psi., psi = $\times 10^{-4}$	Secant Modulus Dynamic Modulus
			Before Compression	After Compression		
14 DAYS						
Group 1..	154.4	2255	5.5	5.3	3.8	0.69
Group 2..	154.6	2280	5.5	.25	3.9 ^a	0.71
Group 3..	...	...	...	...	3.7	0.67
28 DAYS						
Group 1..	155.0	3235	6.1	6.1	4.7	0.77
Group 2..	154.5	3360	6.1	5.9	4.9 ^a	0.80
Group 3..	154.8	3365	6.1	5.8	4.9	0.80
					4.8 ^a	0.79
					4.3	0.70
90 DAYS						
Group 1..	155.1	5040	6.8	6.8	5.6	0.82
Group 2..	155.1	4650	6.7	6.7	5.6 ^a	0.84
Group 3..	155.5	4670	6.8	6.7	5.6	0.84
					5.4 ^a	0.79
					5.3	0.78

Group 1—Dynamic frequency measurements only at all intermediate periods prior to compression for secant modulus determinations at 1000 psi. at breaking period.

Group 2—Dynamic and compression modulus at 1000 psi. at all test periods. Specimens stressed three times to 1000 psi. at each test period.

Group 3—Dynamic and compression modulus at 1000 psi. before and after stressing three times to 2000 psi. at each test period, except at 14 days.

NOTES:

There were three test specimens for each group for each breaking period. Therefore, each figure represents the average of three tests. There were but minor variations between tests on the three specimens in each set.

Concrete data: Five sacks of cement per cubic yard, water-cement ratio 0.85. Slump 1 1/8 in. All test specimens 6 by 12-in. cylinders.

^a See text for description of test procedure. When two secant modulus figures are shown in the same block in groups 2 or 3, they indicate the secant modulus at 1000 psi. after the first and third compressions, respectively, to 1000 or 2000 psi.

ence in trend. The figures shown in Table II represent the average of all tests. Space does not permit the recording of the individual tests in this paper but if of sufficient interest to any reader, copies of a table showing individual tests will be furnished by the author on request.

It will be noted that both the dynamic and secant modulus of elasticity determinations in series II are greater than those in series I even though the average compressive strengths are less. This may be due to the greater density of the specimens in series II, where the cylinder weight averaged approximately 155 lb. per cu. ft. as compared with 150 lb. per cu. ft. in series I. Furthermore, a different aggregate was used in series II than in series I.

The relation of the secant modulus to the dynamic modulus was likewise different in the second than in the first series under comparable test procedure, being approximately 77 per cent at 28 days in series II as compared with 62 per cent at the same age in series I. At 90 days the ratio was 82 per cent in series II as compared to 72 per cent in series I.

SERIES III

Since some tests on slag aggregate concrete were under way at the time the tests in series II were started, the procedure followed for standard aggregate concrete was duplicated for the slag aggregate concrete except that no specimens were stressed to 2000 psi. prior to breaking in the compressive strength tests. The results of the series III tests are shown in Table III.

Although the slag concrete was of lighter weight than the standard aggregate concrete, the compressive strengths were not materially different at 28 and 90 days. The modulus of elasticity by the dynamic and compression

methods was considerably less, however, for the slag than for the standard aggregate concrete. In the case of the slag concrete the modulus averages approximately 5,000,000 psi. for the dynamic modulus and 4,000,000 psi. for the secant modulus at 28 days under a load of 1000 psi. as compared with 6,100,000 psi. and 4,700,000 psi., respectively, for the standard aggregate concrete.

For the slag concrete the ratio of the secant modulus to the dynamic modulus of the previously unstressed concrete ranged from 76 per cent at 28 days to 89 per cent at 90 days as compared with 77 per cent and 82 per cent, respectively, for the standard aggregate concrete in series II.

Successive compressions of the slag concrete to 1000 psi. did not appreciably affect either the dynamic or secant modulus determinations.

TABLE III.—COMPARISON OF THE MODULUS OF ELASTICITY OF SLAG AGGREGATE CONCRETE BY THE DYNAMIC (SONIC) AND COMPRESSION METHODS, WITH PARTICULAR REFERENCE TO THE EFFECT OF REPEATED COMPRESSIONS OF THE TEST SPECIMENS TO 1000 PSI. AT INTERMEDIATE TEST PERIODS AS WELL AS JUST PRIOR TO TEST FOR COMPRESSIVE STRENGTH.

	Weight, lb. per cu. ft.	Com- pressive Strength, psi.	Dynamic Modulus, psi. $\times 10^{-6}$		Secant Modulus at 1000 psi., psi. $\times 10^{-6}$	Secant Modulus Dynamic Modulus
			Before Com- pression	After Com- pression		
14 DAYS						
Group 1*	143.1	...	4.8	...	...	...
Group 2*	143.3	...	4.9	...	...	...
28 DAYS						
Group 1.	143.0	3335	5.0	4.9	3.8	0.76
Group 2.	143.3	3380	5.1	5.0	4.0	0.78
90 DAYS						
Group 1.	143.8	5060	5.7	5.7	5.1	0.89
Group 2.	143.8	4840	5.6	5.6	4.7	0.84

* See description of groups 1 and 2 in Table II.

DISCUSSION

MESSRS. L. P. WITTE¹ AND W. H. PRICE¹ (by letter).—This discussion supplements the information furnished by Mr. Stanton on sonic (dynamic) and static determination of the modulus of elasticity (E) of concrete.

Comparisons of the sonic, compressive, and flexural methods of determining the modulus of elasticity of concrete were made on each of a large number of 3 by 3 by 16 $\frac{1}{4}$ -in. bars, which had been made primarily to measure volume change caused by alkali-aggregate reaction. First, the sonic measurements were made, then the bar was tested as a beam, and finally a section 7 in. long was cut from one end of the bar for the compression tests.

In addition to the elasticity determinations, the modulus of rupture of the bar, modified cube strength of one end of the bar, and compressive strength of the 3 by 3 by 7-in. prism cut from the other end of the bar were determined. The results of all tests are shown in the accompanying Table I.

The apparatus used for the sonic determinations differed from that described by Mr. Stanton in that the bars were vibrated at increased amplitude in their fundamental frequency through a regenerative arrangement of pickup and driver. A check of this apparatus with one similar to that used by Mr. Stanton showed no important dif-

ference in the measured frequency of the specimen. In the flexural tests the bars were supported on self-leveling supports, set 14 in. apart, and the load applied at the third points as described in A.S.T.M. Method Designation: C 78-39. The deflection between the supports was measured by Last Word dials set on each side of the beam at the center of the span. An average of the two dial readings was taken as the deflection at any given load. The apparatus used in the compression determinations of the modulus is very similar to that described by Mr. Stanton.

Specimens used in the tests, having been made primarily for the alkali-aggregate reaction studies, contained a variety of high- and low-alkali cements and different types and amounts of reactive aggregates. The cement content of these specimens varied from one to two barrels per cubic yard of concrete. All specimens contained aggregate graded up to $\frac{3}{4}$ -in. maximum size. The extremely low moduli shown for some of the series are due to disintegration caused by alkali-aggregate reaction. The specimens were two and three years old when elasticity determinations were made by the three methods mentioned above.

Each value shown in the accompanying Table I is an average of three specimens. The spread of results for any three values of E , determined by the sonic method, was very small and the coefficient of variation for companion

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TABLE I.—COMPARISON OF SONIC, COMPRESSIVE, AND FLEXURAL METHODS OF DETERMINING THE MODULUS OF ELASTICITY

Series	Sonic Modulus, psi. $\times 10^{-3}$	Compressive Secant modulus, psi. $\times 10^{-4}$	Compressive E		Flexural Secant modulus, psi. $\times 10^{-4}$		Compressive Strength, psi.		Modulus of Rupture
			Sonic E		Flexural Sonic E		3-in. Mod. Cube	3 by 3 by 7-in. Prism	
AGE OF SPECIMENS—2 YR.									
475...	5.12	2.35	0.46	3.66	0.71	5 190	3590	400	
474...	5.48	4.32	0.79	4.55	0.83	5 620	4100	420	
470...	5.53	4.31	0.78	5.09	0.92	5 620	4360	380	
478...	5.60	4.87	0.87	4.73	0.84	3 520	2630	410	
489...	5.66	6.11	1.08	5.08	0.90	3 810	2880	470	
488...	5.78	5.07	0.88	5.26	0.91	4 100	3180	520	
485...	5.85	5.23	0.89	5.25	0.90	6 120	5490	810	
487...	5.87	4.64	0.79	5.05	0.86	4 130	3230	520	
477...	5.89	4.99	0.85	5.69	0.97	4 030	3300	410	
471...	5.90	5.07	0.86	5.77	0.98	3 620	3030	480	
472...	5.98	4.49	0.75	4.93	0.82	3 540	2720	460	
484...	6.00	4.76	0.79	5.07	0.84	3 510	2890	440	
483...	6.04	5.07	0.84	4.70	0.78	3 550	3130	460	
476...	6.09	4.92	0.81	5.56	0.91	4 100	3170	410	
473...	6.13	4.94	0.81	5.87	0.96	3 600	2890	480	
482...	6.15	5.01	0.81	5.01	0.81	3 840	3050	480	
486...	6.35	5.61	0.88	5.26	0.83	8 620	7680	1040	
469...	6.39	6.11	0.96	6.53	1.02	9 520	8080	980	
467...	6.45	6.12	0.95	5.94	0.92	9 500	8100	1180	
468...	6.56	6.41	0.98	6.53	0.99	11 570	9950	1090	
493...	7.10	6.54	0.92	6.41	0.90	6 530	6340	690	
481...	7.16	6.35	0.89	5.79	0.81	9 200	7750	750	
480...	7.19	6.31	0.88	5.98	0.83	9 640	8260	860	
500...	7.20	6.75	0.94	6.33	0.88	8 830	7810	690	
479...	7.23	6.31	0.90	6.22	0.86	9 010	8430	830	
494...	7.24	6.82	0.94	6.80	0.94	7 110	7670	690	
499...	7.24	6.79	0.94	6.50	0.90	8 730	7520	710	
495...	7.27	6.77	0.93	5.95	0.82	6 910	7300	660	
503...	7.32	6.55	0.89	6.12	0.84	9 080	7110	720	
491...	7.37	7.02	0.95	6.91	0.94	10 470	9320	840	
492...	7.38	6.79	0.92	6.69	0.91	8 390	9050	830	
501...	7.38	7.29	0.99	6.60	0.89	9 070	7760	730	
502...	7.41	6.97	0.94	6.59	0.89	9 130	7870	680	
498...	7.43	6.78	0.91	7.12	0.96	9 550	7480	720	
490...	7.45	6.68	0.90	6.61	0.89	11 130	9540	850	
506...	7.59	6.80	0.90	6.80	0.90	8 910	7400	640	
497...	7.67	7.89	1.03	6.74	0.88	9 320	7350	720	
505...	7.70	7.12	0.92	6.89	0.89	10 050	7860	740	
504...	7.82	6.90	0.88	6.16	0.79	9 990	7630	790	
Avg.	6.64	5.90	0.89	5.86	0.88	7 130	6070	670	
V*	2.0%	6.8%		10.0%					
AGE OF SPECIMENS—3 YR.									
71...	1.52	1.25	0.82	0.83	0.55	4 960	3090	210	
67...	1.80	2.01	1.12	2.44	1.35	5 800	3860	320	
75...	2.00	1.40	0.70	1.27	0.63	5 550	3280	280	
74...	2.07	1.42	0.69	1.25	0.60	5 910	3620	250	
73...	2.11	1.72	0.82	1.31	0.62	5 890	3760	300	
66...	2.69	2.78	1.03	3.48	1.29	6 540	4310	460	
82...	5.21	4.98	0.96	4.55	0.87	7 410	6050	690	
97...	5.27	5.08	0.96	4.55	0.86	7 910	5680	680	
94...	5.33	5.28	0.99	4.40	0.82	8 140	5850	660	
98...	5.33	5.01	0.94	4.85	0.91	7 950	5830	690	
101...	5.35	5.26	0.98	5.03	0.94	8 100	5990	710	
95...	5.42	5.50	1.01	4.46	0.82	8 370	6420	790	
84...	5.48	5.15	0.94	4.53	0.83	8 870	6980	780	
100...	5.50	5.56	1.01	4.68	0.85	8 080	6020	700	
96...	5.60	5.68	1.01	4.58	0.82	9 130	6940	770	
99...	5.60	5.52	0.99	4.71	0.84	8 980	6670	710	
83...	5.60	5.17	0.92	5.02	0.90	8 810	6520	830	
38...	5.64	5.40	0.96	5.77	1.02	8 410	6340	860	
37...	5.65	5.62	0.99	5.45	0.96	8 630	6690	780	
42...	5.67	5.39	0.95	4.68	0.82	8 960	6410	860	
43...	5.76	5.95	1.03	4.97	0.86	8 760	7000	850	
36...	5.77	5.47	0.95	5.00	0.87	8 340	6780	750	
41...	5.77	5.56	0.96	4.86	0.84	8 460	5970	750	
85...	5.91	5.95	1.01	4.86	0.82	9 950	8140	870	
86...	5.93	5.89	0.99	5.38	0.91	10 200	7830	930	
87...	6.06	5.71	0.94	4.91	0.81	9 930	8720	950	
Avg.	4.77	4.60	0.96	4.15	0.87	8 000	5950	670	
V*	2.8%	6.7%		7.8%					
AVERAGE OF 2- AND 3-YR. SPECIMENS									
Gr. avg.	5.89	5.38	0.91	5.18	0.88	7 480	6020	670	
V*	2.3%	7.4%		10.3%					

* V is the corrected coefficient of variation for companion specimens from the same batch (groups of three).
NOTE.—Each value represents an average of three specimens.

specimens from the same batch for the sonic E is only 2.3 per cent. The coefficient of variation for the modulus of elasticity determined by the compressive method is 7.4 per cent and for that determined by flexure is 10.3 per cent, indicating that many less specimens would be required to obtain a true average sonic E than would be required to obtain a true average compression or flexural E .

For the specimens tested at two years, the modulus in compression is 89 per cent and the modulus in flexure 88 per cent of the sonic modulus, and for specimens tested at three years, age the modulus in compression is 96 per

cent and the modulus in flexure is 87 per cent of the sonic modulus. If the modulus in flexure is neglected because of its greater unreliability, then it would appear that the static modulus approached the sonic modulus as the concrete increased in age as Mr. Stanton suggested. This trend exists even though the moduli for the two-year specimens are higher than for the three-year specimens. However, if the values in each age group are analyzed further it will be found that as the modulus increases, the modulus in compression approaches nearer the sonic modulus. That is, there is a larger difference between

the values of E as determined by the two methods at the lower moduli. For the two-year specimens in the range of 5,000,000 psi., the compressive modulus is 82 per cent of the sonic, whereas it is 92 per cent of the sonic in the range upwards of 7,000,000 psi. A large number of other tests, which were made on 4 by 4 by 40-in. beams which had been fog-cured for 90 days and dried for 15 months, showed the flexural modulus to be 95 per cent of the sonic in the range of 3,500,000 psi. and 98 per cent in the range of 6,500,000 psi. It is concluded, therefore, that both the age of the concrete and the magnitude of the modulus have a bearing on the agreement between the sonic and compressive determinations of the modulus of elasticity of the concrete.

It is of interest to note that although the modulus was higher for the two-year specimens than it was for the three-year specimens, the average flexural strength was identical and the modified cube strength was higher for the group with the lower E .

It is realized that the equation used by Mr. Stanton and the writers for computing the sonic moduli is not exact and that the correction factor T is dependent on the choice of the shear constant and Poisson's ratio employed and on

other approximations used in its derivation. Where specimens of the same size and shape are used for comparing the sonic moduli of various concretes the exactness of the formula is of no importance as each value of sonic E contains the same error. In fact, a comparison of the frequencies might serve as well as the computed moduli under such conditions. But where a comparison is made between specimens of different size or shape or between sonic and static values a true comparison may not be obtained.

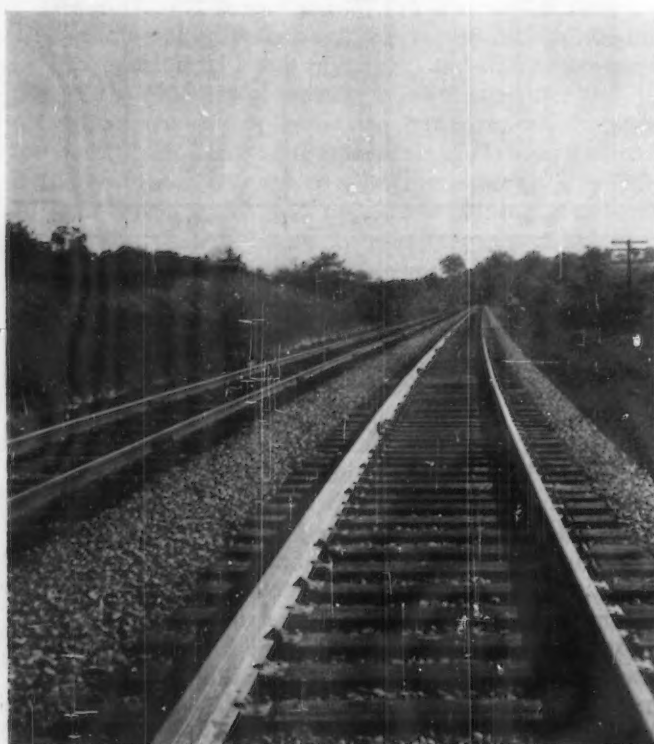
A comparison of the modulus of elasticity of mild steel as determined by the sonic and static methods is presented in the following table as additional information. An SR-4 electrical strain gage was used for measuring the strain in the static determination.

Size of Bar, in.	Sonic Modulus, psi.	Static Modulus in Tension, psi. (1/4-in. square bar)
0.754 by 0.755 by 18.....	30 950 000	...
0.760 by 0.750 by 14.93.....	30 870 000	...
0.755 by 0.755 by 12.03.....	29 510 000	...
0.754 by 0.754 by 6.....	29 330 000	...
Average.....	30 165 000	30 100 000*

* Average of three determinations made on the same bar at different loadings

New A.R.E.A. Ballast Specifications

MANY members of A.S.T.M. and all engineers concerned with track maintenance, specifically ballast, will be interested in the new specifications for prepared stone, slag, and gravel ballast as issued by the American Railway Engineering Association. This standard is also of interest to A.S.T.M. because of the use of several methods of testing standardized by the Society. A detailed article describing the development of the new specifications appeared in July *Rock Products*. Reprints of the specifications are available from the A.R.E.A.,



59 East Van Buren St., Chicago 5, Ill., at 10 cents each. A detailed review of ballast specifications of leading railroads was made and has been reprinted as Circular 24 by the National Sand and Gravel Association.

Stanton Walker, also active in A.S.T.M. committee work, is chairman of the subcommittee responsible for the new standard. Serving with him were the following: F. W. Alexander, A. E. Botts, H. F. Brown, A. P. Crosley, A. T. Goldbeck, A. D. Kennedy, E. R. Lewis, Raymond Swenk, C. S. Wicker.

Following sections on quality and grading requirements, handling and inspection, there are requirements on testing and test methods, and finally information on measurement. Among the A.S.T.M. tests incorporated are the following:

- Sieves for Testing Purposes (E 11 - 39)
- Stone, Slag, Gravel, Sand, and Stone Block for Use as Highway Materials (D 75 - 42 T)
- Sieve Analysis of Fine and Coarse Aggregates (C 136 - 39)
- Amount of Material Finer than No. 200 Sieve in Aggregates (C 117 - 37)
- Clay Lumps in Aggregates (C 142 - 39)
- Abrasion of Coarse Aggregate by Use of the Los Angeles Machine (C 131 - 39)
- Soundness of Aggregates by Use of Sodium Sulfate for Magnesium Sulfate (C 88 - 41 T)
- Unit Weight of Aggregate (C 29 - 42)

The accompanying photograph, courtesy A.R.E.A., shows a well-maintained track and gives some conception of the immense amount of ballast in the track.

Flame Resistance of Thermosetting Plastics¹

By James A. Gale,² R. W. Stewart,³ and J. B. Alferts⁴

RECENT ADVANCES in the development of flame-resistant plastics have accentuated the need for a simple yet comprehensive method of quantitatively evaluating the comparative flammability of these materials. A review of methods presently employed for determining the flame characteristics of common plastic materials indicated them to be inadequate in this respect and, for most thermosetting plastics, wholly qualitative in nature. These cannot be rated beyond being classified as self-extinguishing. It was the purpose of the investigation to develop and devise suitable means for determining the flame-resistant characteristics of thermosetting plastics thus classified.

A flame-resistant material, as defined for this investigation, is one possessing the following characteristics:

- (a) high ignition temperature,
- (b) low burning time,
- (c) absence of smoldering after the flame is extinguished,
- (d) retention of mechanical strength after burning, and
- (e) minimum distortion caused by exposure to test conditions.

The Section on Flammability of Subcommittee III on Thermal Properties, A.S.T.M. Committee D-20 on Plastics, has recently reported 2 methods for testing of materials classed as self-extinguishing in A.S.T.M. Standard Method of Test for Flammability of Plastics Over 0.050 in. in Thickness (D 635 - 44);⁵ one is a modification of this method,⁶ the other makes use of a global heating element operating at 950 C.⁷ The principle of both methods is basically the same; the end of the specimen is held to the ignition source for a specified period of time and flammability determined in terms of length of burned portion and weight loss of the specimen after the source of heat has been removed. The specimen is supported in a horizontal position in both instances.

The method which has been devised and found satisfactory for determining the flame characteristics of thermosetting plastics was developed in the Material Laboratory, Navy Yard, New York, at the request of the Bureau of Ships and is an adaptation of the method presently used by the Navy Department for determining the flame resistance of electric shipboard cables.^{8,9} A Nichrome wire coil is

used as the heating element, with the specimen supported in a vertical position within the coil. Materials are rated in terms of ignition time, or time required to ignite the specimen after the coil is energized; and burning time, or time required for self-extinguishment of the flame after the coil current is shut off. The amount of distortion caused by burning is noted and, where possible, the mechanical strength of the specimen after test is determined.

EQUIPMENT

The equipment consists of a specimen support, heater coil, and spark plugs, arranged in an enclosure of sufficient size. The enclosure is provided with vent holes, distributed around the sides adjacent to the base, to admit fresh air and an exhaust fan at the top, operated at minimum suction just sufficient to carry off smoke and gases. The specimen support is an ordinary four-jaw lathe chuck suitably secured to the base of the enclosure. A sliding door at the front of the enclosure, with shatterproof glass window, permits access to the equipment and a clear view of the interior. Details of the equipment, with the test specimen in position, are shown in Figs. 1, 2, and 3.

The heater coil consists of 7 turns of No. 10 (0.102-in. diameter) Nichrome resistance wire, space wound to 0.25 in. per turn and $1\frac{3}{16}$ in. inside diameter. The coil ends are clamped into heavy copper lugs with the axis of the coil coincident with the axis through the opening in the specimen support and with the lower end of the coil $\frac{1}{2}$ in. above the top of the support.

Two spark plugs with extended electrodes, diametrically opposite, are placed with their longitudinal center lines in a horizontal plane $\frac{1}{2}$ in. above the top of the heater coil, to ignite gases emitted from the heated specimen. The spark plugs are mounted in such a manner that they may be moved to within $\frac{1}{8}$ in. of the surface of the specimen when in operation or away from the specimen after ignition occurs, so as to prevent their electrodes from becoming fouled by soot. A suitable electric circuit is provided to maintain continuous sparking at the electrodes.

Current is supplied to the heater coil through the heavy lugs which are, in turn, connected to the secondary of a transformer. Current is controlled by means of a variable auto-transformer in the primary.

TEST SPECIMENS

Specimens $\frac{1}{2}$ by $\frac{1}{2}$ by 5 in., of the type commonly used for flexural strength tests, were used. Samples of molded materials were fabricated to finished dimensions in a standard test mold and laminated samples were cut from $\frac{1}{2}$ -in. thick sheet stock.

METHOD OF TEST

The heating coil was clamped into the copper lugs, the specimen inserted into the support so that it extended 2 in. above the top of the coil and the spark plugs moved

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¹ The opinions or assertions contained herein are the private ones of the authors and are not to be construed as official or reflecting the views of the Navy Department or the Naval service at large.

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⁵ 1944 Book of A.S.T.M. Standards, Part III.

⁶ Report of Section on Flammability of Subcommittee III, A.S.T.M. Committee D-20; dated February 24, 1943.

⁷ Tentative Method of Test for Flammability of Plastics, Self-Extinguishing Type (D 757-44 T), 1944 Book of A.S.T.M. Standards, Part III.

⁸ Bureau of Ships Specification 15C1; Cables, Electric, Insulated Shipboard Use).

⁹ Federal Specification L-P-406a; Plastics, Organic: General Specifications, Test Methods.



Fig. 1.—Flame Test Apparatus—General Arrangement.

into position near the specimen. A centering device consisting of a wooden mandrel $1\frac{5}{32}$ in. in diameter with a $\frac{17}{32}$ in. square opening in its center was used to exactly center the specimen within the coil. Tests were conducted with a current of 55 amp. passing through the heating coil. To insure similar starting conditions for all samples, the coil was preheated for 50 sec. at operating current and allowed to cool for 100 sec. before the specimen was inserted into the support. The variable auto-transformer was adjusted in the preheat period to provide a current of 55 amp. with the coil hot. (It should be noted that the coil current is greater than 55 amp. for a short period of time after the coil is energized. No attempt was made to compensate for this since the increase amounted to only 1 amp. and the current adjusted itself to 55 amp. within 10 sec.).

A stop watch was started simultaneously with the energizing of the heater coil and spark plugs. The ignition time was noted, ignition being considered as occurring when the flame transferred from the escaping gases to the surface of the specimen and continued there, disregarding the momentary flashes which occurred in the gassing space prior to the sustained flame.

Heating was continued for 30 sec. after ignition occurred, at which time the current to the coil was shut off. The burning time of the specimen was taken as the time

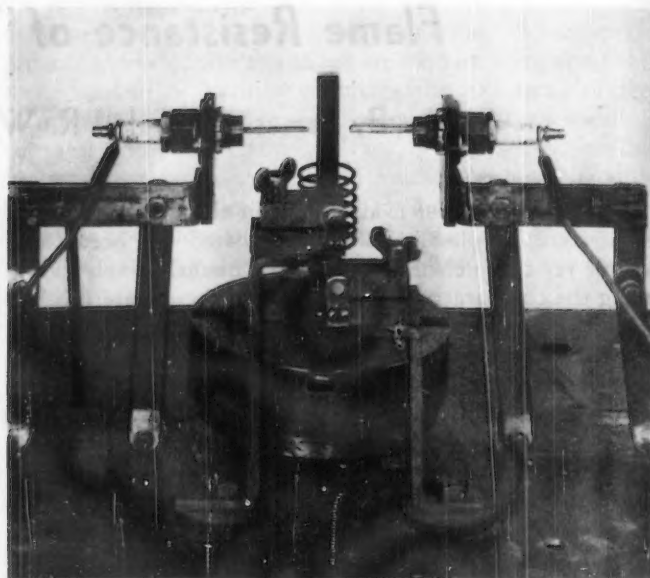


Fig. 2.—Front View of Accessories—Spark Plugs, Heater Coil and Supporting Lugs and Specimen.

required for the flame to extinguish itself after the heater coil was de-energized.

To determine approximately the ignition temperatures of the various materials, a time-temperature curve was developed (Fig. 4). Samples of materials which had been found to be least distorted by the flame test were used. These included mineral filled melamine, asbestos fabric filled phenolic and grade AA (Navy type FBH) materials. Specimens were prepared by notching them on one edge and firmly affixing an iron-constantan thermocouple so

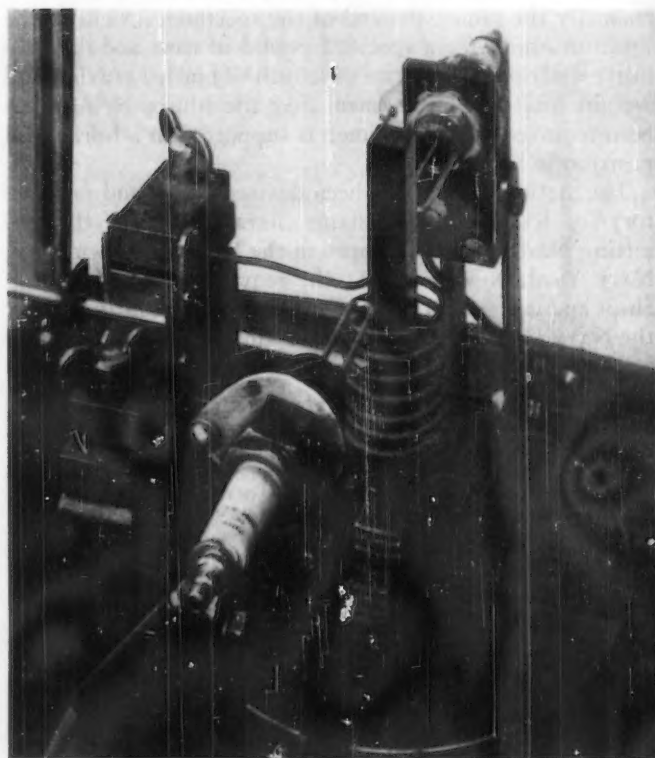


Fig. 3.—Oblique View of Accessories.

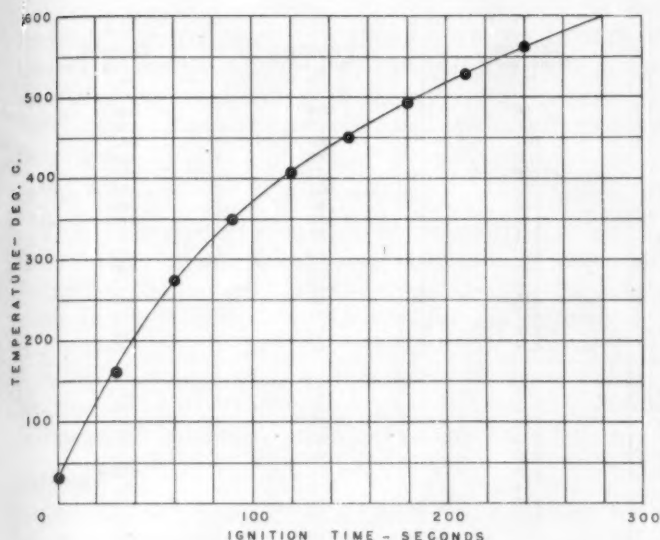


Fig. 4.—Ignition Temperature Conversion Curve.
Coil Current-55 amp.

that the junction was flush with the edge of the specimen. The specimen was placed in the support in such a manner that the thermocouple junction was midway between the top and bottom of the heater coil. The coil was energized and the temperature at the junction noted at 30-sec. intervals with a potentiometer until ignition occurred. The coil current was kept constant at 55 amp.

The mechanical strength of the material after exposure

to flame is a factor which has not heretofore been considered in evaluating flame resistance. Obviously, a material whose strength has been reduced to the extent where it will collapse at slight pressure cannot practicably be considered flame resistant, irrespective of its ignition time, burning time, or other similar characteristics. This can best be illustrated by assuming a large panel board upon which may be mounted thousands of dollars worth of valuable instruments. In the event that the panel board was exposed to a sudden flash of flame, sufficient to cause ignition, far more damage would result if the entire board collapsed than could possibly be caused by the flame itself. The flexural strength of some of the materials after burning was determined and compared with the strength before burning in order to ascertain the extent of this reduction.

RESULTS OF INVESTIGATION

Tests were conducted using 16 molded and 10 laminated types of thermosetting plastic compositions. These are shown in Table I, together with values of ignition time, burning time, and ignition temperature, as determined from Fig. 4. The values of ignition and burning times are the averages of three individual tests.

The burning characteristics exhibited by the materials may be divided into three general classifications. These, in order of decreasing suitability as regards flame resistance, are:

1. Materials to which burning was either confined only to the surface of the specimen or to slight charring of the interior.

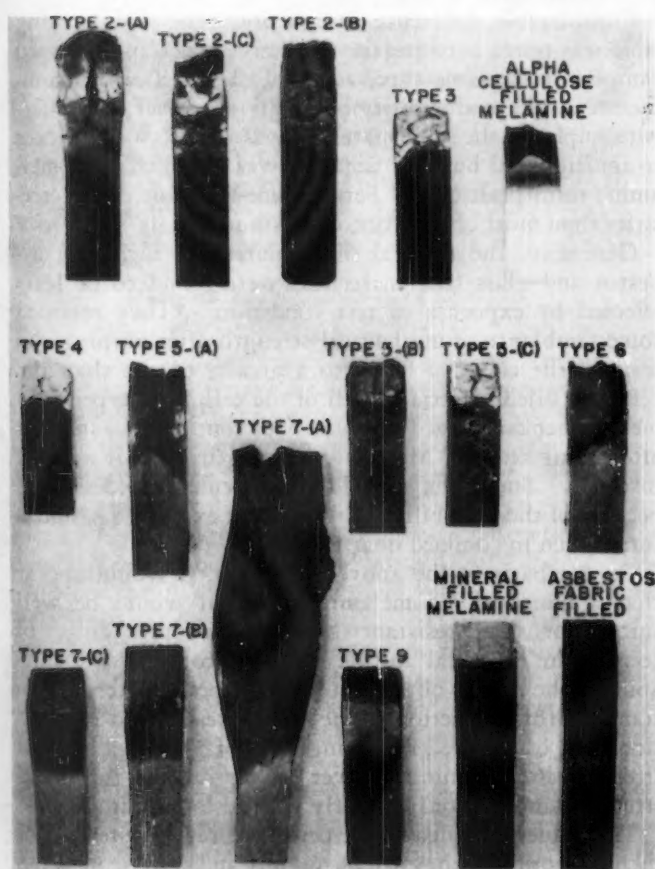


Fig. 5.—Molded Specimens After Flame Test.

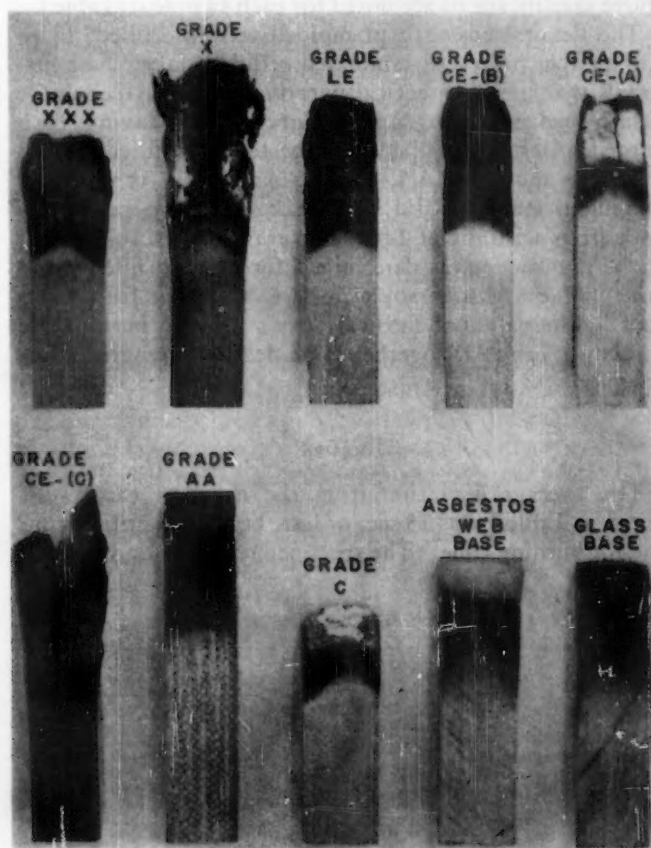


Fig. 6.—Laminated Specimens After Flame Test.

TABLE I.

A.S.T.M. Type or Grade ^a	Navy Type	Burning Classification	Ignition Time, sec. ^b	Burning Time, sec. ^c	Ignition temp., deg. Cent. ^d
Molded Plastics:					
Type 2(a)	CFG.....	Carbonized—brittle	86	298	340
(b)			103	315	380
(c)			107	260	385
Type 3	CFI-5.....	Smoldered	128	282	420
Type 4	CFI-10.....	Smoldered	150	262	450
Type 5(a)	CFI-20.....	Carbonized—brittle	74	303	310
(b)			123	243	410
(c)			142	259	440
Type 6	CFI-40.....	Carbonized—brittle	121	257	410
Type 7(a)	MFE.....	Carbonized—brittle	120	244	410
(b)			128	229	420
(c)			153	213	455
Type 9	MFG.....	Surface Charring	315	52	600+
Asbestos fabric (phenolic)	MFI.....	Surface Charring	177	214	490
Alpha cellulose (melamine)	CFI-5.....	Carbonized—brittle	236	44	555
Mineral filled melamine	MFG.....	Surface Charring	324	52	600+
Laminated Plastics:					
Grade XXX.....	PBE.....	Carbonized—brittle	108	437	385
Grade X.....	PBM.....	Carbonized—brittle	99	427	370
Grade LE.....	FBE.....	Carbonized—brittle	121	356	410
Grade CE(a)	FBG.....	Smoldered	120	260	410
(b)			150	406	450
(c) (melamine)			290	75	600+
Grade C.....	FBM.....	Smoldered	88	388	350
Grade AA.....	FBH.....	Surface charring	175	199	485
Asbestos web base	—.....	Surface charring	152	36	455
Glass fabric base	GBG.....	Surface charring	222	140	540

^a (a), (b), (c) denote same type of material fabricated by different manufacturers.

^b Ignition Time—time required for sample to ignite after heating coil is energized, current—55 amp.

^c Burning Time—time required for self-extinguishment of the flame after heating coil is de-energized.

^d Ignition temperature—as determined from Fig. 4.

2. Materials which become completely carbonized and brittle.

3. Materials which continued to smolder for $\frac{1}{2}$ to 1 hr. after the flame was extinguished, leaving a fine powdery ash as a residue.

Portions of the burned samples are shown in Figs. 5 and 6. The samples of mineral-filled molded materials (except type 7(a)) and grade AA, glass base and asbestos web base laminated materials were sectioned in order to ascertain the extent of burning into the interior of the sample. The above classifications are noted for each sample in Table I.

The flexural strength of molded cellulose filled, laminated paper base, and laminated cellulose fabric base materials was, for all practical purposes, zero. All could be easily broken when tapped lightly after having been burned. All mineral filled and asbestos fabric filled molded materials and grade AA, glass base and asbestos web base laminated materials did not break when dropped to the floor from a height of 2 ft. Flexural strength subsequent to the flame test was determined for mineral filled melamine, grade AA, asbestos web base, and glass base materials. The values of flexural strength after burning are shown in Table II, together with flexural strength before burning.

ERRORS

The average deviation from the mean of the results noted in Table I was 15 sec. or less, both for ignition time and for burning time. The specimen to specimen variation

for the same material may be attributed partially to lack of constant conditions in the test equipment, such as current variations and changes in air draft, and partially to nonuniformity of the material itself.

DISCUSSION OF RESULTS

The degree of flame resistance, as previously defined, of the various types of plastic materials was easily determined when samples were tested in accordance with the above method of test.

Considerable difference in ignition time and burning time was noted between the respective types and between samples of the same type, as supplied by different manufacturers. Reproducibility of results, however, for different samples of the same materials was good. With respect to ignition and burning times, it was found that the melamine resin plastics had better flame-resistant characteristics than most of the phenolic resin materials.

Generally, the mineral filled materials (including asbestos and glass base materials) were found to be least affected by exposure to test conditions. They retained some semblance of mechanical strength after burning and resisted the effect of flame to a greater extent than the cellulose filled materials. All of the cellulosic type specimens either carbonized completely or continued to smolder after being tested. Mechanical strength was nil in both instances. Smoldering would be particularly undesirable, because of the possibility of ignition of explosive gas mixtures when in confined quarters.

On the basis of the above discussion, it would appear that a mineral-filled melamine material would be well suited for flame-resistant applications (providing, of course, the electrical and mechanical properties are suitable). The results obtained for this type of material substantiate this deduction. The sample tested had an ignition time of 324 sec., a burning time of 52 sec., a flexural strength after burning of over 30 per cent of its initial strength, and was only slightly warped by burning.

The values obtained in the performance of the test are of such a nature that they can be quickly and easily converted into their more practical aspect; the determination of the

TABLE II.—FLEXURAL STRENGTH.

	Navy Type	Application of Stress with Respect to Molding Pressure	Flexural Strength, psi.		Average Reduction in Strength, per cent
			Before Burning	After Burning	
Mineral filled melamine	MFG	Parallel	10 900	3 100	70
		Normal	11 600	3 900	
Grade AA.....	FBH	Parallel	15 400	3 350	75
		Normal	15 300	3 550	
Asbestos web base.....	...	Parallel	30 700	7 300	65
		Normal	32 200	16 000	
Glass fabric base.....	GBG	Parallel	27 500	5 400	80
		Normal	36 700	6 850	

ignition temperature of the material. The importance of this value is self-evident, in that the ultimate user of the plastic is concerned only with the maximum temperature to which the material may be exposed without immediate failure.

CONCLUSIONS

The above method of test affords a quantitative indication of the comparative flame resistance of materials formerly classified only as self-extinguishing. The differences in the flammability characteristics, as imparted by the inherent properties of the particular resin, type of filler, molding technique, etc., are sufficiently divergent and can be determined with sufficient accuracy to permit the establishment of limits of flammability on this basis.

Addenda:

Samples of laminated glass fabric base melamine resin material and molded ebony asbestos board (asbestos filler

with asphaltic bitumen resin) were tested subsequent to the preparation of the paper. The melamine resin plastic did not ignite after 500 sec. exposure to test conditions. It was not distorted except for slight delamination between glass layers and the reduction in flexural strength amounted to 65 per cent. The asbestos board had an average ignition time of 154 sec. (ignition temperature 450 C.) and a burning time of 77 sec. It was not distorted by burning and reduction in flexural strength was 65 per cent.

Acknowledgment:

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The Interpretation of Laboratory Tests as Quality Indices in Textiles

By A. Griffin Ashcroft¹

EDITOR'S NOTE: This paper should be of interest not only to those materials and testing engineers and technologists concerned with so-called ultimate consumer goods but to all in the testing fraternity. Mr. Ashcroft, a member of the Society's special Committee on Ultimate Consumer Goods and also of the special Study Committee which is investigating all phases of the Society's operations, is also Vice-Chairman of Committee D-13 on Textile Materials. This paper was presented at the Fall meeting of the American Association of Textile Chemists and Colorists (AATCC) and was published in the November issue of their *American Dyestuff Reporter*. Discussion of the paper is invited.

GROWTH OF LABORATORY TESTING

LABORATORY TESTING in the textile field has grown during the past decade to be a potent force in research, standardization, and quality control. In fields other than textiles, a much longer history stands behind laboratory testing. In the field of structural engineering, for example, many data have been collected on the properties of a great variety of materials of construction. The public has not been burdened with very many of these data for there is little of personal interest in such characteristics as the tensile strength of steel or the compressive strength of concrete. In recent years, however, the public has been a sounding board for advertising promotion dealing with the test results of cigarettes for nicotine content, of the durability of mattresses, and the potency of insecticides and vitamin pills. The impression that *all* tests initiated by technicians, engineers, and scientists may be applied without restrictions in the defining of quality, not only for research or quality control,

but as a measure of the degree to which products would fill human wants, has been created and is, I am afraid, being nurtured by the failure of technicians to limit and restrict tests to the use for which they have been designed and developed.

We have learned that the translation of the art of textile manufacturing into a science of production requires the development of methods of measurement, the collection of data, and the translation of newly acquired knowledge into action. Many of us in the scientific fields have spent a good deal of time and effort convincing management and our colleagues in production and sales of the need for laboratories, equipment, and personnel for the testing of raw materials and products. In this effort we have been part of a growing company. A report of the National Research Council (1)² in 1940 includes, with other significant data, a survey of the startling growth of research and development laboratories in the United States during the past twenty years. Measured in terms of research personnel an increase from 10,000 in 1921 to over 70,000 in 1941 and a probable 100,000 in the postwar years, indicates a significant change in the internal organization of our industrial system. The value of groups of research chemists and engineers in the development of textile products and improvements in process is receiving increasing recognition, although many phases of the test methods which have made their research results possible are little understood.

THE TEXTILE INDUSTRY—POSTWAR

It is interesting to note that economists (2) are predicting a breakdown of the barriers between the various sciences and a great expansion of the research picture of

¹ Director of Research, Alexander Smith and Sons Carpet Co., Yonkers, N. Y.

² The italic numbers in parentheses refer to the reports and papers appearing in the list of references appended to this paper.

the fabricating industries of which the textile industry is an obvious part. Research and development emphasis in these fabricating industries will be on the usefulness or utility of a material rather than upon the use of some available basic raw material such as cotton or wool of which the supply happens to be economic or accessible. The chemist, physicist, and engineer will be working in the laboratories of the fabricating industries primarily in the interest of the consumer of his product, rather than for the owner or user of large stocks of traditional raw materials. The implications of this general statement may not be fully appreciated without considerable discussion but it is a potential change in emphasis deserving the thoughtful consideration of textile technologists.

INCREASING DEMANDS FOR TESTS

We should consider at this time how these changes in emphasis will affect laboratory testing and its relation to the consumer of our products. If we are developing goods with a growing emphasis on filling human desires, it would seem that pressure for tests as evidence of relative quality will increase and the influence of laboratory testing on the producer and consumer alike will grow like a mushroom. We can foresee a rising demand for new tests developed to measure length of service, maintenance of aesthetic values, and a mixture of human desires extremely complicated in nature. The combining of the sciences, the rise of the fabricating industries, and the expansion of research facilities and personnel each suggest an era of new problems in test development and interpretation. I am suggesting that we have felt, so far, only a breath of the problems in the interpretation and use of tests. Carelessness, inertia, and an indiscriminate attitude about tests may make us partners in and not opponents of the growth of a whirlwind of perversion of testing into a form of scientific quackery.

A CONSERVATIVE USE OF TESTS NEEDED

I may seem to be more concerned about this danger of the development of testing into a pseudo-science than has been indicated to some textile engineers by their own experience. We may lack experience with the growth of an evil and yet be part of it. The relative infancy of laboratory testing and its limited application to wide fields of quality in textiles may have a delayed impact on chemists and engineers in the textile fields. In fields where the engineering sciences were the originating source of product development, laboratory testing has been an active force in product research but has not been emphasized in promoting utility values even though the testing was more directly related to service than are most textile tests. The testing of a motor, for example, has been standardized, but these tests are not presumed to measure service life. Extensive use of service tests of automobiles in proving grounds aided in the improvement of the auto for better service but no claims or labels resulted. We can understand better, it seems, the distinction in the proper use of testing in products of a mechanical nature where performance value is a mechanical problem than we can where it is more personal as in blankets or dresses. Most types of tests developed for textiles up to this time are not closely related to human desire. The tensile strength of blankets is far removed from the real but complex reasons we pur-

chase certain blankets, that is, for lightness in weight, warmth, color, thickness, kind of fiber, or cost. An excellent paper (3) recently published by the National Bureau of Standards indicates entirely different tests as criteria for human value. Their complexity may help to indicate their great value in research and development of blankets, even if they are difficult, if not impossible, to use in consumer promotion. It may be that as the textile industry develops its knowledge through improved tests it too will become conservative in the use of laboratory tests and will use testing to a greater degree in its legitimate spheres of influence—in research, in standardization, and in control.

Perhaps that term "conservative" should be defined because I am implying that the present trend in the application of testing in the textile industry may be the antithesis of conservatism. George Cutten (4) defines a conservative as a person who has an open mind to the *proved values* of the past, and wishes to be reasonably sure of his course before he disrupts the conditions under which these values have developed and matured. Now, the conditions under which the valuable engineering test procedures have been developed in the past have been under the fire of the slow, careful forces of scientific, engineering criticism. The tests have been confined to their specific uses and not to advertising or to labeling or to promotion of value or to guaranteeing value to a consumer. They were not developed for that purpose and conservatively they were not launched on the strange uncharted course of a guarantee of fulfilling human desires by testing.

MISUSE OF LABORATORY TESTS

Some of the perversions of laboratory tests for strange uses are known to all. You are familiar with the promotion of value and the desire for cigarettes on the basis of nicotine content tests, length of burning tests, and reduction of throat irritation tests. Promotion of germicides by tests, showing superiority of one disinfectant or germicide over another, was current a few years ago. Fortunately for human health war-promoted research on germicides has outstripped the advertisers and test comparisons. These are perhaps the extremes of perversion but the list of less obvious misuses of tests is long. Some of our thinking on labeling of textiles has a similar motivation. It can be demonstrated that the identification, for example, of fiber content as required now by law has no relation in many instances to durability or other consumer values.

While Research Committees are still improving and developing tests for sun-fastness and wash-fastness qualities in textiles, the untried, uncorrelated tests are being promoted as standards for consumer value relationships. It is time that textile chemists restricted the use of their tests to fields covered by their data. Before use in war service indicated that tests were inadequate, we had many erroneous ideas of the relation between laboratory tests and the actual values in the field of textiles treated for water, fire, and weather resistance. Tests which we assumed measured utility of cloth for hot or cold climates have been made obsolete by war-stimulated service data. These are only a few examples in the textile field. Perhaps our war production experience has brought a touch of

humility and in future promotions of new test methods for over-all measures of human wants we shall insist on the tempering, corrective data of actual use and the constructive criticism of the data by our associates; thus, we no longer will oversell laboratory tests or through inference or general language infer that they are designed as final measures of quality or wantableness.

TYPES OF QUALITY CRITERIA

There are good reasons for combining a new humility with our renewed effort in the development of tests for quality criteria. I recall Dr. Walter Shewhart's definition (5) several years ago of "quality" because it brought home the complicated nature of the broad values of which each of our tests was a small part. He said "a standard of quality which is satisfactory, adequate, dependable, and economic from a long range viewpoint" might change "whenever the developments in the field of applied science make such changes desirable." Each of these terms defining quality includes the myriad variables of the wants of human beings and their way of living.

Certainly it is evident that we cannot *standardize* the satisfaction everyone obtains from the different values, dependabilities, or economies of the products we buy, the houses we build, the cars we drive, the foods we eat, or the amusements and sports we enjoy. We cannot and do not wish to limit the textiles we make to one type with known test wear-life dependability and thus disregard the value of economy to some, or of style satisfaction to others. This business of attempting to simplify wantableness in terms of a few of the quality characteristics that happen to be covered by laboratory tests is not science. It is not even good common sense. Let us, as engineers, be more wary of slogans and labels based upon a few indices of human wants and develop test methods which serve to an even greater degree to add to our knowledge of the properties of the materials we use and thus promote more quickly the development of new products which give wider satisfaction, adequacy for specific use, dependability in performance, and an ever-greater economy through greater human productivity.

Perhaps if we classified the types of quality our tests were designed to measure we would tend to better their design and to limit their applications. In general there are three types of quality (5) and a real need for tests for the evaluation of each type. "The first type is that which characterizes a thing independent of all other things and of human volition and interest." This type is illustrated by the measurements of basic chemical or physical values such as those for mass, velocity, or density. Let us refer to this type as quality of type I. In textiles, measurements of quality of this type and classifications based thereon have had limited publication. It was a pleasure to many to hear the 1944 A.S.T.M. Edgar Marburg Lecture this year by Dr. Harold DeWitt Smith³ detailing his study of textile fibers as engineering materials. His data on properties of textile fibers illustrate quality characteristics of this first type. Quality terms of this first type invariably include in their use a

precise definition of the test method. The test results usually are independently verifiable data in a state of statistical control. Tests of this type are rarely misapplied. They are used as signposts for thinking and a sure guide toward new products.

Type II quality might be defined as "that which characterizes a thing A in its relation to another thing B and independent of human volition or interest." This type is the more common quality value measured, for example, by laboratory tests for weather resistance, for aging, for heat transmission or tests for many other use relationships. Tests measuring this type of quality are the basis of most applied research.

The third quality type may be defined as that which makes a thing wanted by some group of people. Tests of type II are frequently dressed up with a little bit of human desire and confused with type III. A product having such attributes is, of course, the ultimate goal aimed at by every producer of goods for sale. It is not difficult to recognize that the thing which makes an automobile desired is the way it operates and performs and not the qualities of its parts as defined by type I or II and the laboratory tests used to measure these qualities. In textiles, however, this distinction is less obvious but we are misdirecting our efforts if we attempt to interpret quality of type III, wantableness, in terms only of color-fastness to light or to washing or of weight or count or strength. We are more certain to meet the very real demand for improved utility and serviceability and wantableness through research and the extending of effort toward improved materials and design. We should suppress our desire to measure relative operational values with its myriad human and environmental variables by some simple test or comparison. We would save millions of dollars wasted each year if we could divert this effort to measure comparative ultimate consumer value in the direction of the development of improved real values. It is possible, if we did this, that some small part of the buying public might suffer in relative purchasing power because of errors in judgment, but the consumer as a whole gains most through the knowledge obtained from continuous experiment stimulated by competition. Research and testing help to improve the qualities which make a product desired and thus increase its satisfaction, adequacy, dependability, and economy for the consumer.

PROBLEMS OF INTERPRETATION

The problem of interpretation of tests is a very complicated matter. Interpretation depends, first, as has been indicated, upon the aim or goal of the test. Which type of quality was it designed to measure or to compare? Measures of quality of one type rarely, if ever, have easily interpreted meanings for another type. The test must be designed specifically for and limited in use to one type of quality characteristic.

If the test is designed to measure quality criteria, independent of human interest, it cannot be *assumed* also to be an adequate measure of a degree of human desire. Interpretation is influenced also by the intent of use of the test. Laboratory tests are generally used to increase knowledge in three fields in manufacturing—Research and Development, Specification, and Standardization, or Quality Control. They may be designed for research into the

³ Harold DeWitt Smith, "Textile Fibers—An Engineering Approach to Their Properties and Utilization," *Proceedings, Am. Soc. Testing Mats.*, Vol. 44 (1944).

properties of a material or the effect of conditions of heat or cold or moisture upon the physical or chemical structure of materials or compounds. Because this field of application is generally basic science, we have been educated by our experience to insist upon evidences of precision and of accuracy before we accept the results of new or untried tests. A growing field of demand for tests is in *applied research* where comparison of properties of products is of real value in guiding experimental judgment. An illustration of tests in this field would be the wear-test machine developed for carpet wear comparisons and in constant use by the carpet companies in aiding the development of new constructions, comparisons of production methods, and choice of raw materials. Tests designed for comparisons of quality of type II for use in applied research require less precision than those for basic research or for measures of human interest. The Carpet Wear Test, for example, has a range of error in its present state of development of more than ± 5 per cent. Repetitive tests and elimination of all variables but one in applied research testing make it valuable for this type of test use. However, its use for wear-value comparisons of grades of carpet of different manufacturers would have little meaning even if sufficient tests were made (estimated to be about 20 different series in many cases)—even with great improvement in the precision of the present test and equipment. Rarely have sufficient correlations with service been carried out with tests of this type which prove, by repetitive data, that comparisons of product A with B would mean to the consumer that the products would perform in a similar fashion in service. I recall an excellent study of service of dresses made from cloth, tested and rated in the laboratory, reported at a meeting of the Committee on Household and Garment Fabrics of A.S.T.M. Committee D-13 on Textile Materials. In this study the rating by laboratory test was confirmed by service data for about 60 per cent of the products. The conclusion was suggested that the variables of the service test were the cause of some poor correlation. It was evident also that the test itself was 'an inadequate indication of the relative human usefulness of these fabrics in actual service. We cannot claim that lack of correlation of service with testing is due to *lack of control of the variables in service*. Rather, we should conclude that tests designed only for quality comparisons independent of human desires cannot be properly used to grade fabrics for characteristics associated with complex human desires and uses. Tests cannot be used to give numbers to one or two quality characteristics and the hidden values ignored.

NEW ATTITUDE TOWARD TESTS

The foregoing is an attempt to show the need for a new attitude toward laboratory tests. The attitude needed is one which will promote the development of test methods which are more precise, and also those properly designed and limited to its quality type. This new attitude would stimulate resistance to the misuse and perversion of tests in promotion, in advertising, in labeling, or in bureaucratic control of manufacturing and would help develop a new approach to meeting the needs of the consumer.

The new attitude toward laboratory tests would be expressed in certain changes in pace and actions which

might be called the scientific method. Some of the rules we should follow are:

1. Insist that any new test proposed for adoption be accompanied by data showing satisfactory measures of reproducibility, that is, the precision of the test.
2. Insist that the scope or use of the test is limited to the scope of the data upon which it is based.
3. Insist that the limitations of the test are stated so that it cannot be misapplied through assumptions that it includes applications not covered by data.
4. Insist that the sampling technique is carefully outlined and that the number of tests for a given precision is presented.
5. Insist that data be presented showing satisfactory agreement in results (a state of statistical control) between tests made by skilled operators in several laboratories.
6. Insist that the original data be presented so that the evidence is available for all the predictions of the value of the test believed to exist.
7. If the test is assumed to predict quality characteristics under service conditions, insist that a correlation with service use be presented and not merely *assumed*.
8. Do not use tests of a single quality feature to prove human desirability or wantableness if the product is desired for many *different* quality features; and, unless a test covers the hidden values, and not merely a single quality characteristic, its use in sales promotion is a perversion of textile laboratory testing.

DEVELOP A SCIENCE OF TEST METHOD PRESENTATION

One way to implement our new attitude toward laboratory tests is to follow an improved method of *test presentation* in our reporting on old and new test techniques. A standard form of presentation might go a long way toward limiting the test to its legitimate field of usefulness. Such a form of presentation might be developed from the following suggested outline:

Using language which is definite and with all predicted applications based upon stated data which convey knowledge supporting the conclusions:

1. Give the Purpose of the Test Method
 - (a) State its relationship to the quality characteristics it has been used to measure.
 - (b) Refer to its major use as indicated by data, that is, in Research, Development, or Control of finished product.
 - (c) Give its possible relationship to service values and if these relationships are unsupported by data, so state.
2. State to what materials or products it has been applied and indicate that its use for other products should be supported by data before it is so used.
3. State its limitations where known.
4. Describe the test method in complete detail so that it would be unlikely that one would assume from the description that changes in the method or equipment could be made without effect on the precision of the test.
5. Describe the method of sampling and give data to indicate the precision of the test for a stated number of samples.

6. Include data supporting the conclusion that a skilled operator or laboratory will obtain values within a *stated* range of the average of the test results of a number of laboratories.
7. Avoid conclusions that the test is useful in indicating service performance unless correlating test data are shown.

CONCLUSIONS

The natural desire of technicians in the textile field to find the proper test methods for defining minimum quality values of textiles seems to have developed problems difficult to solve. In this paper an attempt has been made to show how our tests can be applied with less error in application and in the interpretation of the test results than has been prevalent. The major problem, however, of attempting to show how tests for type III quality can be developed and measures of human wants devised has not been answered. Dr. Walter Shewhart of the Bell Telephone Laboratories suggested that we try to find out what are the objective human wants in terms of the science developed to define them, namely, psychology. A starting point for action therefore might be the organization of a small group or committee consisting of a psychologist, a research engineer, a statistician, and a chemist in the textile field. This group might indicate and

classify human wants in textiles. Such a classification of wants might direct our attention anew to the development of test methods measuring these wants and away from further use of count, weight, or strength tests to indicate the wantableness of a textile. The textile industry should work toward this goal—increased public service through better classification of human wants.

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Testing Speed Specifications

By George C. Ernst¹ and LeRoy W. Empey¹

THE EFFECT of testing speed upon the physical properties of various materials has received considerable attention and study in recent years.² The testing engineer, however, is confronted with a chaotic situation with regard to testing speed specifications. In order to present a general view, all three parts of the 1942 Book of A.S.T.M. Standards were reviewed for the specific purpose of interpreting speed requirements. In reviewing the sections concerned with the determination of physical properties, it was found that the testing speed requirements could be placed in 21 classifications as shown in Fig. 1. It should be apparent that many of these classifications contain requirements which are extremely inconvenient or impossible to meet with certain types of acceptable equipment.

In specifying testing speeds, consideration should be given to (a) the action of various types of testing machines and equipment during the testing of specimens, (b)

the effect of testing speed on the physical properties to be determined, and (c) the convenience of application of the requirement.

ACTION OF TESTING MACHINES DURING TEST

A few characteristics are common to all machines when under load. Briefly, these consist of the removal of inelastic deformation due to slippage of wedge tension grips and lack of perfection of mechanical fit; the transfer of weight of crosshead, attached equipment, and loading screws; and the elastic deformation of the loaded portions of the machine.

In addition to the above factors, a mechanically driven machine may have belt slippage and slowing of motor speed, and hydraulic machines will have increasing leakage as the load is applied. Proper belt adjustment or the use of chain drives, the use of constant speed motors, and a means of compensating for oil leakage are corrective features common enough to be accepted as standard requirements for proper testing equipment. Mechanical machines with variable speed motors, although offered by testing machine manufacturers and occasionally used in research testing, are found only infrequently in commercial or school laboratories.

In general, the removal of inelastic deformation and the transfer of weight of crosshead with attached equipment and loading screws occur sufficiently early to permit primary consideration of only the elastic properties of the

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² P. G. Jones and F. E. Richart, "The Effect of Testing Speed on Strength and Elastic Properties of Concrete," *Proceedings*, Am. Soc. Testing Mats., Vol. 36, Part II, p. 380 (1936).

P. G. Jones and H. F. Moore, "An Investigation of the Effect of Rate of Strain on the Results of Tension Tests of Metals," *Proceedings*, Am. Soc. Testing Mats., Vol. 40, p. 610 (1940).

L. H. Fry, "Speed of Tension Testing and Its Influence on Yield Point Values," *Proceedings*, Am. Soc. Testing Mats., Vol. 40, p. 625 (1940).

FIGURE 1. TESTING SPEED REQUIREMENTS IN A.S.T.M. STANDARDS

INDIVIDUAL TESTING SPEED REQUIREMENTS IN PARTS I, II & III OF A.S.T.M. STANDARDS FOR 1942		VARIOUS COMBINATIONS ^a OF TESTING SPEED REQUIREMENTS IN PARTS I, II & III OF A.S.T.M. STANDARDS FOR 1942																				
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
Load rate ^c specified	Rate of stressing ^b (p.s.i. per min. or pounds per min.)	X		X			X	X	X					X			X					
	Equivalent rate in pounds per min. (no specific value provided)											X										
Cross-head speed specified	Unloaded speed specified.		X	X	X																	
	Uniform speed during test.					X	X	X	X	X	X	X										
	Loaded and unloaded conditions not clearly defined.												X	X				X				
	Speed specified for yield strength determination only.														X	X						
Misc. and/or supplementary requirements	Loading to be started without shock.			X					X	X												
	Increase in speed permitted for ultimate strength determination.				X											X						
	Any convenient rate permitted up to 50 percent of ultimate.							X									X	X				
	Based on constant rate of fiber strain.										X											
	Range of time limited for a required deflection.																	X				
	Minimum time limited up to failure.																		X			
	Slow application of load during test.																			X		
	No testing speed requirement.																					X

^aWhen a load rate and a cross-head speed are both checked, they are alternates.

^bNo limitation placed on cross-head speed or amount of valve opening, even though cross-head speeds are frequently offered as an alternate.

^cNumerical values of testing speeds were provided unless otherwise noted.

testing machine.³ It is evident that the loss in head motion due to elastic properties of a machine⁴ is a function of the rate of change of load rather than the magnitude of the load, since a constant load during a period of increasing deformation will produce no additional elastic deformation of the machine. The actual head speed, therefore, varies inversely with the stiffness of the specimen and directly with the stiffness of the testing machine, reaching approximately unloaded head speed whenever deformation increases without load increase⁵ (that is, at maximum load or at a true yield point). For axial loading, virtually all of this crosshead speed will be transferred into the entire length of the specimen as rate of strain, with the exception, of course, of the slippage occurring when wedge tension grips are used.

This transition toward unloaded head speed as a specimen yields (stiffness decreasing) will be more abrupt for brittle specimens than for ductile specimens. Furthermore, a material which exhibits a constant stiffness up to the breaking strength will permit no transition of cross-

head speed toward unloaded speed until after actual fracture. Such a condition, however, is not of primary interest, since most of our commonly used structural materials provide sufficient yielding near the maximum load to permit virtually complete transition to occur.

In view of these considerations, the following facts should be kept in mind when formulating testing speed requirements:

1. With a properly adjusted testing machine,⁶ the actual crosshead speed during test approaches the unloaded head speed as the stiffness of the specimen diminishes and equals the unloaded head speed whenever deformation increases without load increase.

2. With fittings having virtually no inelastic deformation losses during axial tests, the unloaded head speed is practically attained as rate of strain over the entire effective length of the specimen whenever deformation of the specimen increases without load increase.

3. With fittings having considerable inelastic deformation losses throughout the tests, such as wedge type of tension grips, the rate of strain for axial tests will be much lower than the unloaded head speed even at a time when the deformation of the specimen increases without load increase.

³ Exceptions are: (a) the slippage of wedge grips in tension tests, since such slippage continues to fracture, (b) the use of machines with excessively heavy crossheads, or low capacity specimens tested in large machines.

⁴ In testing a very ductile material, the elastic properties of a screw power machine will change appreciably during test due to the shortening of the effective length of the loading screws.

⁵ The authors have made tests on five different types of machines to confirm this feature. The work of Jones and Moore (footnote 2) appears to support this conclusion, and L. H. Fry (footnote 2) has presented an interesting analysis on the stiffness properties of testing machines.

⁶ The calibration requirements for testing machines should include the proper adjustment of the driving mechanism, an unloaded head speed calibration for mechanical machines, and a means for determining the loaded head speed of hydraulic machines.

EFFECT OF TESTING SPEEDS

The effect of testing speed on the commonly specified physical properties, in so far as our present published information indicates, cannot be considered as extremely critical. Nevertheless, it is true that, in order to assure comparable results from different laboratories, some limitation should be placed on testing speed. In general, a variation as great as 50 per cent above or below a required speed would not affect any of the commonly specified properties by more than 1 per cent. Furthermore, it is not a prerequisite that the actual speed be maintained within such limits throughout the entire period of testing if the stiffness of the specimen decreases at a rate which permits a sufficiently gradual transition of head speed to a value within the specified limits at the attainment of the property under consideration or if a sufficiently gradual transition is made by manual means of control.

CONVENIENCE OF APPLICATION

In the opinion of the authors, it is highly essential that a speed requirement be convenient to apply, particularly if it is to be effective. The operator should be able to meet the specification with any machine meeting the requirements of A.S.T.M. Standard Methods of Verification of Testing Machines (E 4 - 36),⁷ with, perhaps, the addition of dial indicator or metronome or stopwatch for determining head speed or loading rate. One of the important features to be considered is that a large variety of testing speeds are not available on most mechanically driven machines. A common combination is the 0.05, 0.1, 0.2, 0.4, 1, 2, 4, and 8 in. per min. furnished on eight-speed machines. Six-speed machines generally have 0.05, 0.1, 0.2, 1, 2, and 8 in. per min. available, but a large number of acceptable four-speed machines will continue to be used having only $\frac{1}{8}$, $\frac{1}{2}$, 1, and 4 in. per min.

Mechanically driven machines, without variable speed motors, are further limited in that a loading rate in pounds per minute cannot be applied without unusually, dexterous manipulation of the controls. Furthermore, it is economically difficult to justify a change from a constant- to a variable-speed motor to control loading rate, in view of the fact that the effect of testing speed on the commonly specified physical properties is not extremely critical.

Hydraulic machines, of course, are quite flexible, the control valve permitting a choice of testing speeds from zero to several inches per minute, and any loading rate in pounds per minute up to the ability of the recording system to follow the load.

Such specifications in Fig. 1 as No. 1, which require a rate of stressing without an alternate in the form of an unloaded crosshead speed, or Nos. 5 through 11, which require uniform crosshead speeds during test, cannot be met conveniently with mechanically driven machines having constant-speed motors.

An "equivalent rate in pounds per minute," used as an alternate but with no specific value or means of computing the "equivalent rate" does not provide any control and may as well read "or a convenient rate in pounds per minute may be used."

There seems to be no merit in several of the miscellaneous and supplementary requirements in Fig. 1. "Loading to be started without shock" and "slow application of

load during test" are dependent solely upon the operator's interpretation of the meaning of "shock" and "slow." The limitation of a "minimum time up to failure" or "range of time for a required deflection" cannot assure uniformity of testing speed, since the actual rate at fracture or any other point can be high or low depending upon the rate used during the other stages of the test.

A testing speed specification "based on constant rate of fiber strain" can be met reasonably well for most flexural tests, but for direct tension or compression would require intricate controlling devices which would operate directly from the gage length of the specimen. Although such devices are commercially available, the cost is prohibitive for the results obtained, in so far as commercial testing is concerned, and must be supplemented by manual control in the plastic region.

An important objection to any loading rate in pounds per minute (or pounds per square inch per minute) is that it is not possible to maintain such a rate beyond the point at which the specimen yields at a rate equal to the maximum speed of the machine in inches per minute. Therefore, some operators will have the machine traveling at its maximum speed by the time of fracture. This may amount to several inches per minute and will vary considerably for different machines. Testing speed specifications based on loading rates in pounds per minute, without a limit on loaded crosshead speed are susceptible to variations in operators' techniques and may promote rather than prevent variable results.

In considering these features, it appears more advantageous to provide a specification limiting the unloaded head speed of mechanical machines and the loaded head speed of hydraulic machines.

A SUGGESTED FORM FOR TESTING SPEED SPECIFICATIONS

1. In determining the ultimate strength:

(a) The unloaded crosshead speed of a mechanical testing machine or the loaded crosshead speed of a hydraulic machine, at loads above 50 per cent of the estimated ultimate strength, shall be within plus or minus 25 per cent of — in. per min.,⁸ excepting that this speed may be multiplied by — for an 8-in. gage length or by — for a 2-in. gage length when wedge grips are used in tension tests,⁹ and

(b) Any convenient speed may be used up to 50 per cent of the ultimate strength.

2. In determining yield strength or any elastic property: The crosshead speed of the testing machine or the rate of load application may be any convenient value sufficiently lower than those stated for ultimate strength to permit load-deformation relationships to be observed.¹⁰

3. If the speed limitations imposed by item 1 cannot be met, the operator shall choose the nearest available speed and record this speed as part of the essential data of the test.

⁸ If this speed is chosen from a combination such as $\frac{1}{16}$, $\frac{1}{8}$, $\frac{1}{4}$, $\frac{1}{2}$, 1, 2, 4, and 8 in. per min., the specification could be met without difficulty, and would still provide adequate control on speed.

⁹ In the case of wedge tension grips, it would seem satisfactory to double the value for an 8-in. gage length or multiply it by four for a 2-in. gage length in order to obtain straining rates on the specimen which would be comparable to those for more rigid fittings (see report by Jones and Moore, footnote 2).

¹⁰ An appropriate speed, although slow, may be estimated by assuming a 2-min. lapse of time up to the estimated yield strength, in order to provide approximately 6 sec. between each of 20 increments.

⁷ 1942 Book of A.S.T.M. Standards, Part I, p. 889; Part II, p. 996; Part III, p. 840.

Current Procedures in Operating So-Called Accelerated Weathering Units¹

Results of Questionnaire

Prepared by R. W. Matlack²

FOR A NUMBER of years arguments have raged pro and con as to the suitability and value of what are popularly called "accelerated weathering machines" for the evaluation of protective coatings. During the past two or three years, the Armed Forces have demanded quick answers to the question of the serviceability of specification materials and have, therefore, included an accelerated weathering test in many of their specifications. Many suppliers have had difficulty in correlating results in their own laboratories with those obtained by laboratories of the Armed Forces. This increased use of the machines has emphasized the importance of trying to standardize some of the variables which are known to be present in their operation.

For this reason Group 1 of Subcommittee VII on Accelerated Tests for Protective Coatings of Committee D-1 was asked to send out a questionnaire to all users of accelerated weathering machines in the protective coatings field. The purpose was to find out how many users pay particular attention to the control of these variables and to what degree they feel this control affects the results of the test. A preliminary report was made to Subcommittee VII at the A.S.T.M. Annual Meeting in June which created quite a bit of interest. As a consequence, it was recommended that the results of the questionnaire be published for the information of the general membership.

The questionnaires were sent to a list of approximately 180 individuals, the majority of which were obtained from the two manufacturers of accelerated weathering machines. The list was restricted, in so far as possible, to those who had some connection, either as manufacturer or consumer, with the protective coating industry. Ninety-one replies were received which in two or three cases were reports on two or three machines operated by the same user. In addition, four declined to answer, due to the fact that their experience with the machine was limited, while one declined to answer, stating that his company's experience had been so unsatisfactory in regard to correlation of results that the use of the instrument had been discontinued. The answers received are tabulated below, together with additional comments on those questions which created unusual interest.

1. Do you control the temperature of the air at the specimens?
Yes 25 No 62 Partial 4
- (a) At what temperature range? 95 F. to 160 F.
5 deg. range—13
10 deg. range—6
15 deg. range—1
20 deg. range—2

¹ Prepared at the request of Subcommittee VII on Accelerated Tests for Protective Coatings of Committee D-1 on Paint, Varnish, Lacquer, and Related Products.

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- (b) By what means?
Fan or blower—11 Fan, heater and ext. cooling coil—2
Thermoregulator—6 Thermostat and ext. spray—1
Cold air blast—1
- (c) Have you any data on temperatures actually developed at the panel surface?
90 F. to 180 F.; depends on color of panel, whether upper or lower rack, whether spray is operating
2. Do you control the relative humidity at the specimens?
Yes 5 No 86
- (a) At what range? } 75 \pm 10 per cent—uniform temperature and air across pool of water—1; Constant temperature and humidity room—1
- (b) By what means? }
3. Is there positive circulation of air within the instrument to maintain uniform temperature?
Yes 48 No 41
- (a) By what means?
Exhaust fan on arc—47
Blower set for panel fac. temperature of 140 F.—1
4. Do you control the temperature of the spray water?
Yes 6 No 85
- (a) Is the control at the source or at the specimens? Source—6
- (b) At what temperature range?
45 F. to 90 F.; usually within 10 deg.
- (c) By what means?
Reservoir in laboratory—1 Deep well—1
Method of piping—3 Refrigeration unit—1
- Discussion.—One user feels that the control of the temperature of the spray water is extremely important. Reference to the summary will indicate that very few users are paying much attention to this at the present time. The suggestion has been made that the spray water be kept in a reservoir maintained at 95 to 100 F. Another user is at the present time controlling water temperatures by means of a refrigeration unit which maintains a constant temperature of 50 \pm 3 F. He thinks that the use of cold water is extremely important in the evaluation of exterior house paints due to the shock factor.
5. Do you control the composition of the spray water?
Yes 6 No 74 Partial 11
- (a) To what range? } Distilled water—2 Condensed, filtered steam—1
Treated city water—9 Ionac resin—1
Pure source—2 Filter—1
Chemically treated plant water—1
- (b) By what means? }
- (c) Have you investigated or tried systems for treating water?
Explain.—Tried deep well water, city water and recirculated distilled water, city water proved satisfactory (550 ppm. solids). Several are investigating deionizing methods. One, testing coatings on cloth, had to install extensive treating system to remove iron. Filter tank with carbon to remove iron.
- (d) What is the total solids content of your water in parts per million? Very wide range from negligible to 550:
0 to 50—12 200 to 250—5
50 to 100—5 250 to 300—1
100 to 150—9 550—1
150 to 200—7

Discussion.—A number of users commented on the importance of water composition. However, very few do anything more than take advantage of normal city water. Several, however, have expressed interest in purification by the use of ion exchange resins or similar methods. One user comments that if the spray water is not kept free of dissolved salts and suspended matter, there will be an accumulation on the exposed sections of the panels which will tend to give misleading conclusions.

6. Do you control the volume and pressure of the water spray?
Yes 27 No 61 Partial 1

(a) At what ranges? 25 to 65 psi.

(b) By what means?

Pressure valve—10; others use manual valve with visual observation to secure full, wet spray or keep panels wet

(c) Is spray continuous or intermittent?

Continuous 37 Intermittent 35

Answers are not significant, as one type machine has continuous fixed spray which hits the panels intermittently

7. Is exact type of water spray defined and kept standard?

Yes 56 No 19

(a) Explain: *Standard nozzles used.*

8. Do you control the voltage and amperage at the arc?

Yes 83 No 7

(a) At what values?

At manufacturer's rated values with equipment furnished with machine

9. During a test, does your machine run continuously for the entire period except for carbon changes?

Yes 42 No 48

(a) If not, how long are the shut-down times?

1 hr.—1 4 to 14 hr.—1
2 hr.—1 1 1/4 hr. daily + 48 hr. weekend—1
4 hr.—5 3-4 hr. daily + 24 hr. weekend—1
5 hr.—1 8 hr. daily + 16 hr. weekend—1
6 hr.—5 24 hr. weekend—1
8 hr.—5 38 hr. weekend—2
12 hr.—2 3 days weekend—1
14 hr.—10

(b) Do you feel that shutdowns or rest periods have an effect on results? In what way?

No effect—19 Accelerates failure—1
Nearer regular exposure—5 Over 24 hr. accelerates failure—1
Slows down failure—5 Increases checking failure—2

Discussion.—The comments as to the effect of shutdown periods show a rather wide difference. You will note that 19 think they have no effect, while 5 believe that failure is slowed down. Two state that failure is accelerated and 5 think that they more nearly duplicate exterior exposure. One user has a special cycle consisting of 8 hr. lamp only, 10 hr. lamp and intermittent spray, and 6 hr. intermittent spray only. He advises that the drying-out period of 8 hr. with the lamp only is necessary, especially for tests on wood panels. One of those who stated that a shutdown accelerates failure thinks that it is due to the cooling and subsequent changes in dimension of the coating. Another feels that rest periods permit moisture to leave the panels and thus retard failure. Another uses a 24-hr. rest period every Sunday and is thus able to more readily reproduce fading such as obtained on Florida exposure. Another advises that a shutdown for three days over the weekend gives less rapid breakdown but more uniform and correlative results. Another thinks that a shutdown for 6 hr. in every 24 hr. produces a more satisfactory result since he feels the instrument is too severe when run continuously. Another uses a special cycle with a definite sequence of exposure factors which has been quite successful in correlating instrument results with those obtained by outdoor exposure in

Florida and his industrial midwest location. The first exposure of the panels is for a period of 5 hr. to light and intermittent water spray. Panels are then subjected to a night condition of 14 hr. water spray without light. This cycle has shown excellent reproduction of failures in alkyd type formulations by water blistering, loss of adhesion, and flexibility when compared to outdoor exposure. Rest periods are held to a strict minimum, as they have found that reducing the moisture content of the panels leads to abnormally low flexibility results in the case of oleoresinous materials.

10. When testing organic protective coatings, do you have a standard period for drying or conditioning panels before starting tests?

Yes 55 No 27 Partial 3

(a) Of what duration for various types?

Lacquers	Synthetics	Air Dry Enamels	Bake Enamels	Oil Paints	Miscellaneous
2 hr.—1	18 hr.—1	48 hr.—4	24 hr.—7	7 days—6	24 hr.—6
12 hr.—1	48 hr.—1	72 hr.—4		10 days—1	48 hr.—6
24 hr.—6	72 hr.—8	7 days—7			72 hr.—6
48 hr.—3	7 days—1	2-7 days—1			5 days—6
					7 days—8
					10 days—1
					14 days—1
					5 to 30 days—1
					7 days at 100 F.—1
					5 hr. at 140 F.—1

Discussion.—There were a number of different comments received regarding the effect of a standard conditioning period for protective coatings. An examination of the times shown above will indicate the extremely wide range now used. Most of those who commented thought that a definite period for various types of finishes should be used, as otherwise results will not be uniform. Often abnormal failure was noted, such as wrinkling, whitening, etc., in cases of early exposure. One user comments that adequate drying prevents solvent blistering and wrinkling. Several comment on the fact that when standard aging periods are used repeat tests can be duplicated. Another advises that air-dried paints must be properly cured, as otherwise chalking or cracking failures will develop due to high heat in the instrument, which is not comparable with exterior exposures. Another has found that 24-hr. drying is not sufficient for oil paints, but that very little difference has been found between 48 and 72-hr. periods. It would seem that a standard conditioning period would be essential for adequate test procedure and would be one of the easiest of the variables to control.

11. Is first 24 hr. of the exposure normally made with water spray operating or with light alone?

Spray and light—75; Light only—5

Light 1 1/2 hr.—1

Light 2 hr.—1

Light 6 hr.—1

Light 8 hr.—2

Discussion.—As can be seen from the answers above, practically all users operate with both the light and water spray for the entire period of exposure. Several of those using this system find that, otherwise, the results would not be fair, as the high heat of the light alone would tend to bake the finish on the panel. Another using this same system would be unable to change, since panels are put into the machine at any time and it is impossible to disturb the cycle because of the panels already under test.

One respondent who operates with light alone for the first 8 hr. states that this accelerates the hard drying of the coating, but does not know the effect on the results. Another who operates with light alone for the first 24 hr. thinks that finishes are susceptible to early and abnormal failure when

exposed to water while still "green." Another operating with light alone finds that their results indicate that satisfactory failure is more rapid.

The foregoing tabulation does not include the report sent back by one of the manufacturers of these instruments.

From information given therein, it would seem possible to secure an instrument having much finer controls than the ones now in use. The most recent models control the temperature of the air at the specimens by means of a 600-ft.-per-min. blower controlled by a thermoregulator having a working range of 110 F. to 180 F. This is usually satisfactory for a temperature of 130 ± 4 F. The relative humidity at the specimens can also be controlled from 30 to 60 per cent by means of a water spray and air blast. By means of a special control, which is furnished on order, the temperature of the spray water can be controlled within a range of 80 F. to 120 F. There is, at the present time, no standard control for the composition of the spray water. However, he seems to feel that reasonably soft tap water run through a green sand and charcoal filter to remove free solids would be satisfactory. The water pressure is controlled by means of an adjustable pressure regulator for a range of 10 to 50 lb. and is normally kept between 22 and 25 lb. The type of water spray can be kept standard by means of a choice in nozzles differing in volume per minute. He also advises that the machine should run continuously for the entire period of test except for carbon changes since he has found that long rest periods only prolong the test without producing any noticeable change in the final results. Please note, however, that this is at variance with some of the comments received from users.

In addition to the variables covered by the questionnaire, some of those answering suggested other items which they think were equally important. Two respondents indicate that film thickness should be defined and standardized since they think it plays an extremely important part in the final result. Another states that the type of panels used should be standardized, advising that he generally uses wood panels for house paints, floor enamels, etc., and metal panels for tank paints, industrial finishes, and specialties. He finds that the wood panels generally break down the film more rapidly than metal panels, due to their greater shrinkage and expansion. This user also thinks that an accelerated weathering machine only demonstrates trends in the evaluation of house paints, but that it is indispensable in the evaluation of enamels. One of those commenting on film thickness states that he is investigating the use of doctor blades for the application of uniform films and also the application of a standard volume of paint to the test panel, the amount being determined from the weight per gallon and the spreading rate.

Another user comments that his instrument is operated according to the recommendations of the manufacturer with no added gadgets or controls. He states that whenever he runs a test, there is included in the series a material of known performance and, if possible, of similar formulation. He does not attempt to evaluate results in terms

of exterior durability, but uses the results for the purpose of comparison only and as a guide to further formulation. The final results on any series are obtained from exposures on Florida racks. The correlation between the instrument and Florida racks has not been good. Similarly, another user includes a standard formula paint in every series of house paint tests and retains a duplicate unexposed panel on all enamels for comparison of gloss and color change at the conclusion of enamel tests.

One company uses a mercury arc machine, presumably of their own design, which seems to produce quite satisfactory results. The air temperature in this instrument is controlled between 115 and 130 F. or 145 and 160 F. by means of a circulating fan, strip heaters and a water-cooling coil. The relative humidity is controlled at 75 ± 10 per cent by controlling the temperature and blowing air across a pool of water. They are also fortunate in having a water source with a year-around temperature of 80 to 90 F. The water spray is used for two $2\frac{1}{2}$ -hr. periods per week. The instrument does not run continuously but is shut down for several 8-hr. periods during the week, as well as the week end. These shutdowns seem to produce failures more nearly resembling those obtained on an exterior rack.

Another user comments that he has used three types of instruments over a period of several years. The first was of his own design and more recently two of standard manufacture. However, he has been unable to secure satisfactory correlation of results with either of these machines and exterior exposure.

Another respondent uses his instrument mainly to determine the rate of chalking of white pigments and has found good correlation between the machine and a 45-deg. S fence in Virginia. In order to secure satisfactory results, however, he found it necessary to replace the iron piping in his water supply with Saran tubing to eliminate the deposition of iron salts on the panel face.

It seems clear from the replies received from this questionnaire that there is a great lack of uniformity in testing by accelerated weathering machines. Therefore, before the industry can expect to secure comparable and reproducible results, steps need to be taken to control as many of the variables as possible. A special group of Subcommittee VII, therefore, has been established to develop standardized operating conditions for accelerated weathering test units. It is expected that this group will be in a position to render a final report before the first of the year.

At the same time, it might be well for all users to consider the advisability of clarifying the name of the instrument and the test. Quite a few have commented that a term such as "artificial light and water exposure" or "accelerated light and water resistance test" would more nearly describe this operation, inasmuch as the instruments measure the effect of only a few of the many variables experienced in the outdoor weathering of protective coatings.

Standardization of the Shape and Size of Electrical Contacts

SOON AFTER THE organization of Subcommittee X on Contact Materials of A.S.T.M. Committee B-4 on Electrical Resistance Alloys for the purpose of developing standard tests for electrical contacts, it became evident to the committee that the problem was considerably complicated by the great variety of shapes and sizes of electrical contacts on the market. Accordingly, an investigation was made to determine the possibility of standardizing the shapes and sizes of the most commonly used electrical contacts. The shortage of materials also made such a procedure important as a conservation measure.

This proposal was favorably received by both manufacturers and users of contacts. Accordingly, Section C on Standardization of Contact Forms and Sizes, of Subcommittee X, was organized.

This section, composed of representatives from the principal manufacturers and users of electrical contacts,

has been working on this problem for the past four years, in cooperation with the National Electrical Manufacturers Association. Thus far standards have been completed for contact rivets and for projection welding contacts.

These standards have been developed by a questionnaire system, in which all of the principal users and all of the manufacturers of electrical contacts were given an opportunity to express themselves, both toward the matter of standardization and the suggested standard dimensions. Approval has been unanimous, and the results are here published for the first time.

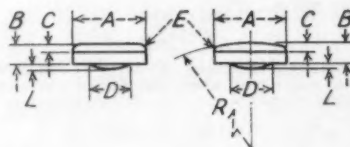
It is recommended that manufacturers and users of electrical contacts adopt these as their standards for production and for electrical design.

The committee is now working on standard dimensions for contact tipped screws and studs. The results will be published as soon as the committee has completed its work.

STANDARD DIMENSIONS FOR PROJECTION WELDING CONTACTS

1. NOMENCLATURE

- A = Head diameter.
- B = Total head thickness.
- C = Thickness of contact material.
- D = Diameter of projection.
- L = Height of projection.
- E = Radius of break at edge of contact.
- R = Spherical radius of face.



2. STANDARD DIMENSIONS

		A..... D..... L..... E.....	0.125 0.078 0.006 1/64 max.	0.187 0.125 0.100 1/64 max.	0.250 0.156 0.100 1/32 max.	0.312 0.187 0.102 1/32 max.	0.375 0.187 0.102 1/32 max.				
			Value of C		Value of C		Value of C		Value of C		
Ratio ^a	B	Flat	Domed ^b	Flat	Domed ^b	Flat	Domed ^b	Flat	Domed ^b	Flat	Domed ^b
1:4	0.031	0.008	0.011	...	...	...	...	...	...	...	...
1:2		0.016	0.018	...	...	...	...	...	...	...
2:3		0.021	0.023	...	...	...	...	...	...	...
1:4	0.047	0.012	0.015	0.012	0.016	0.012	0.017	...	...	...	...
1:2		0.024	0.026	0.025	0.027	0.024	0.028	...	...	...	...
2:3		0.032	0.033	0.033	0.034	0.033	0.035	...	...	...	...
1:4	0.063	0.016	0.019	0.016	0.020	0.016	0.021	0.016	0.022	0.016	0.023
1:2		0.032	0.034	0.033	0.035	0.032	0.036	0.033	0.036	0.032	0.037
2:3		0.043	0.044	0.044	0.045	0.043	0.045	0.043	0.046	0.043	0.046
1:4	0.078	...	...	0.020	0.024	0.020	0.025	0.020	0.026	0.020	0.027
1:2		...	...	0.040	0.042	0.040	0.043	0.040	0.044	0.040	0.045
2:3		...	...	0.054	0.055	0.053	0.055	0.053	0.056	0.053	0.056
1:4	0.093	...	...	0.024	0.027	0.024	0.028	0.024	0.030	0.024	0.031
1:2		...	...	0.048	0.050	0.048	0.051	0.048	0.052	0.047	0.052
2:3		...	...	0.064	0.065	0.063	0.065	0.063	0.066	0.063	0.066
1:4	0.125	...	...	...	...	...	...	0.032	0.038	0.032	0.039
1:2		...	...	...	...	...	...	0.064	0.068	0.063	0.068
2:3		...	...	...	...	...	...	0.085	0.087	0.084	0.088

^a Table shows values of "C" for contacts having ratios of contact material volume to total volume of 1:4, 1:2, and 2:3 as indicated in first column.

^b On domed contacts radius of spherical face 2.5 A.

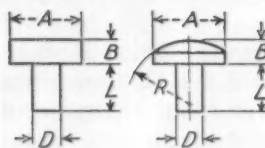
3. TOLERANCES

	Head Diameter under 0.250 in., in.	Head Diameter 0.250 in. and over, in.
A = Head diameter	±0.003	±0.005
B = Total head thickness	±0.003	±0.005
C = Thickness of contact material	±0.003	±0.003
D = Diameter of projection	±0.005	±0.008
L = Height of projection	±0.002	±0.003
E = Radius of break at edge of contact	1/64 max.	1/32 max.
R = Spherical radius of face	±1/32	±1/16

STANDARD DIMENSIONS FOR CONTACT RIVETS

1. NOMENCLATURE

A = Head diameter.
 B = Head thickness.
 D = Shank diameter.
 L = Shank length.
 R = Radius of face.



2. STANDARD DIMENSIONS

Shank Diameters (D) for Contact Rivets, Dimensions in Inches.

Head Diameter, A , in.	$1/32$	$1/8$	$3/32$	$1/16$	$7/32$	$1/4$	$5/16$	$3/8$	$7/16$	$1/2$	$5/8$
Head Thickness, B , in.											
0.015	0.045	0.062	...	...	...	...	...	...	...	...	...
0.020	0.045	0.062	...	...	...	...	...	...	...	...	...
0.025	0.045	0.062	0.078	0.078	0.092	...	...	...	...	...	...
0.031	0.045	0.062	0.078	0.078	0.092	0.092	0.125	0.156	...	...	...
0.040	0.045	0.062	0.078	0.092	0.092	0.092	0.125	0.156	...	...	...
0.047	0.062	0.062	0.078	0.092	0.092	0.125	0.156	0.156	...	...	...
0.062	...	...	0.092	0.092	0.092	0.125	0.156	0.156	0.187	0.187	0.250
0.078	...	...	0.092	0.092	...	0.125	0.156	0.187	0.187	0.250	0.250
0.093	...	...	...	0.092	...	0.125	0.156	0.187	0.187	0.250	0.250
0.125	...	...	...	...	...	...	0.156	0.187	0.187	0.250	0.250
Shank Length, L , in.											
$1/16$	x	x	x	x	...	...	...	...	...	...	...
$3/64$	x	x	x	x	...	...	...	...	...	...	...
$1/32$	...	x	x	x	x	x	x	...	...	...	...
$1/8$	...	...	x	x	x	x	x	x	x	x	...
$3/16$	...	...	...	...	x	x	x	x	x	x	x
$1/4$	...	...	...	...	...	...	...	x	x	x	x

Face radius $2\frac{1}{2}$ times head diameter.

3. TOLERANCES

	Under 0.10 in. Shank Diameter	Over 0.10 in. Shank Diameter
A = Head diameter	± 0.002	± 0.003
B = Head thickness	± 0.002	± 0.002
D = Shank diameter	± 0.001	$+0.001$ -0.002
L = Shank length	± 0.005	± 0.005
R = Face radius	$\pm 1/32$	$\pm 1/16$

4. SHANK INDENTATION

Diameter of indentation to be $1/3$ diameter of shank. To have 90 deg. included angle. Shank indentation to be included on rivets only where specified by customer.



Discussion of Paper on the Salt Spray Test¹

Submitted by Arthur C. Hanson:²

The paper is an excellent discussion of the salt spray test and indicates that a considerable amount of work and thought has been applied to the determination of certain variables in the test.

However, I disagree with the author's method of calculating relative humidity in the salt spray cabinet. Relative humidity is the ratio of the measured vapor pressure to the equilibrium vapor pressure. The equilibrium pressure in the salt spray cabinet is the vapor pressure of the salt solution and not that of pure water. Therefore, a relative humidity of 84 per cent as calculated by Mr. Darsey for a 20 per cent salt solution should be 100 per cent. Using the correct method of indicating the relative humidity in the salt spray cabinet, there is no difficulty in

understanding how a wet or dry spray in the cabinet depends on the moisture content of the incoming air.

It must be remembered that the humidity of the air measured before it passes through the nozzle cannot be taken as the humidity of the incoming air. Assume saturated air under 15 psi. pressure and at the temperature of the cabinet. Upon expansion to 0 pressure, the volume is doubled, the moisture per unit volume is decreased 50 per cent and the temperature is decreased about $1/2$ deg. Fahr. In order to obtain a wet spray, the incoming air must be presaturated at a temperature sufficiently above that of the cabinet to have a resulting relative humidity after expansion above 100 per cent with respect to the spray. To obtain this humidity, air under 15 psi. pressure must be heated to 113 F. and saturated with respect to pure water. As 100 per cent saturation is difficult to obtain, a slightly higher temperature in the saturator is recommended.

The statement is made in the paper that "Regardless of the size of salt fog particles in the cabinet, they will even-

¹ V. M. Darsey, "The Salt Spray Test," ASTM BULLETIN No. 128, May, 1944, p. 31.

² Captain, Ordnance Dept., Rock Island Arsenal, Rock Island, Ill.

ually fall and be collected” Apparently Mr. Darsey’s salt spray cabinet has no outlet provided for the spray. However, air under 10 psi. pressure entering a cabinet from four nozzles must find some means of escape through cracks or around doors. Some salt fog particles will be carried out with it or deposited in these cracks. In cabinets provided with an outlet, it is obvious that the smaller salt particles will be carried through the cabinet and out of the exhaust port. The fog particles collected will therefore be the larger particles emerging from the spray nozzles or those which have increased in size in the cabinet.

As the vapor pressure of fog particles increases with decreasing size of the particles, the smaller particles might tend to disappear if it were not for the fact that evaporation increases the salt concentration which in turn decreases the vapor pressure. It is assumed that a point of equilibrium will be reached in these smaller particles where they will neither increase nor decrease in size. The probability of such particles settling out in the cabinet will be very low. The larger particles having lower vapor pressures will tend to increase in size if the vapor pressure of the incoming air is higher than that of the equilibrium pressure of these larger particles.

The above discussion assumes constant temperature conditions in the cabinet.

With the exception of the above objections, I agree in general with Mr. Darsey’s paper. The salt spray test cannot be standardized without recognizing the variables in the test and making an attempt at controlling them. The humidity is a variable of considerable importance.

In considering the cause of corrosion of panels in a salt spray cabinet, I have arrived at the following as influencing factors and variables upon which these factors depend.

- I. Amount of spray precipitated on test specimens.
 - A. Amount of spray impinging on test specimens.
 1. Angle and direction of specimens with respect to flow of spray.
 2. Amount of spray precipitated in the cabinet.
 - B. Rate of flow through the box.
 1. Air pressure in the line.
 2. Nozzle size.
 - C. Baffle size and position.
 - D. Temperature between interior and walls of cabinet.
 1. Temperature of box.
 2. Ambient temperature.
 3. Temperature of incoming air.
 4. Size of box.
 - E. Relative humidity in the box.
 1. Relative humidity of incoming air.
 - (a) Temperature of air.
 - (b) Pressure of air.
 2. Temperature of salt solution.
 3. Temperature of the box.
 4. Salt concentration of spray.
- II. Temperature of the box.
 - A. Temperature of incoming air.
 - B. Temperature of salt solution.

- C. Ambient temperature.
- D. Amount of cooling due to expansion of the air.
 1. Air pressure.

- III. Concentration of salt spray precipitated on the test specimens.
 - A. Salt concentration in the solution.
 - B. Relative humidity in the box.
 - C. Relative humidity of the incoming air.
- IV. Composition of salt solution.
 - A. Sodium chloride solution.
 1. Per cent of sodium chloride.
 2. Per cent and types of impurities.
 3. Purity of water.
 - B. Synthetic sea water.
 1. Per cent sodium chloride.
 2. Per cent magnesium chloride.
 3. Per cent of sodium sulfate.
 4. Per cent of calcium chloride.
 5. Per cent and types of impurities.
 6. Purity of water.
- V. Composition of air.
 - A. Per cent of oxygen.
 - B. Per cent of carbon dioxide.

MR. V. M. DARSEY³ (*author's closure, by letter*).—The statement “Reference to Table I reveals that at equilibrium the atomizing of a 20 per cent salt solution results in a relative humidity of 84 per cent inside a test cabinet” is made in the subject article. Mr. Hanson, in his discussion states—“The equilibrium pressure in the salt spray cabinet is the vapor pressure of the salt solution and not that of pure water. Therefore, a relative humidity of 84 per cent as calculated by Mr. Darsey for a 20 per cent salt solution should be 100 per cent.”

It is agreed that the equilibrium condition in the salt spray cabinet is governed by the vapor pressure of the salt solution. For this reason, the vapor pressures of salt solutions of various concentrations at 30 C. and 40 C. were shown in Table I. These vapor pressures were expressed in millimeters of Hg which is an absolute measure of the amount of water in gaseous form in the air under the prescribed equilibrium conditions. In order to have a means of measuring the amount of moisture in the gaseous phase, the liquid salt fog particles were removed from the air by filtering through fritted glass, and wet and dry bulb temperatures determined. These readings, when referred to handbook tables, gave a relative humidity value. When equilibrium conditions with 20 per cent NaCl were obtained, the wet and dry bulb temperatures indicated 84 per cent relative humidity by the standard handbook tables, and the results were so reported.

Rather than establish new data for wet and dry bulb temperatures, it was considered most practical to express results in conventional terms. To express the equilibrium of a 20 per cent NaCl solution as 100 per cent relative humidity would require compiling a table for a very specific set of conditions where the relative humidity would be reported as 75/84 or 89 per cent for a dry condition, and 100/84 or 119 per cent for a wet condition; that is, for a system containing no NaCl in the fog, and only water, at equilibrium with the atmosphere.

³ President, Parker Rust-Proof Co., Detroit, Mich.



DECEMBER 1944

NO. 131

TWO-SIXTY
SOUTH BROAD ST.
PHILADELPHIA, PENNA.

The Future of Testing

WHAT OF THE future status of the testing of materials? There are some who believe that the next decade will see a remarkable rise in dynamic testing with less emphasis on the now current static tests. Some feel that we must emphasize as much more important the performance type of test even though under the best of conditions it may be a long way from giving a true evaluation of a product in service. Again there are some who are enthusiastic about some of the newer non-destructive tests—for example, the use of supersonics. This was evident at one of the round tables sponsored at the National Metals Congress. There are indications that supersonics and other types of electrical or electronic investigations may be extremely helpful.

Such evaluation as it seems valid to make of the progress in the testing of materials during the past 40 to 60 years indicates great developments, but not the sudden abandonment of one system of test for a complete new one.

In this BULLETIN one author refers to the relation of the radiographic investigation to magnetic particle testing, where they too, may supplement one another rather than considering either one gives the complete answer in all cases.

The testing in the future, of course, is directly related to the developments in the fields of materials. Some believe we will see the rise of composites of which there are now many examples—wood impregnated with plastics, the bonding of like and even unlike materials, and other forms. Many of these combinations are modifications of older materials or introduce new materials with desirable properties, but which will surely need tests peculiar to their nature.

Then we have the question of ultimate consumer goods and also the testing of parts and assemblies. The Society through special committees is studying both of these very ramified fields.

From the foregoing two reasonably well founded conclusions ensue—first, there would not seem to be any decreased interest in testing or great decline in the amount that will be done. It should be expected that newer testing technique will be developed.

There would accordingly appear no need for the testing or materials engineer to worry about the future of his particular activity, but he will need to be alert and keenly alive to technical activities and research that is under way in the field of materials.

Effective Service

IT IS CERTAIN that the entire membership of the Society is highly gratified with the Society having been given the Distinguished Service Award of the Ordnance Department of the War Department. All must have felt a sense of pride in that the war efforts of such a heterogeneous group as our Society had been so highly evaluated by the Staff of the Chief of Ordnance. Even those members who from force of circumstances beyond their control were more like observers on the side lines than actual players in the game have doubtlessly felt highly gratified.

During the interim between the last and the present war, activities within the Society progressed on the basis of knowing what the job at hand was and how it might best be done with the least effort. This required intensive study of the methods and the materials at hand and of alternate methods and materials. Such study developed a broad knowledge and a personnel with the knowledge. In the process of this development individuals met and presented individual viewpoints. From these developed group ideas and viewpoints and consensus of opinions. From these there was finally evolved the end products—specifications, methods and valuable compilations of data.

It is this spirit of individual thinking and working leading into unanimity of results which the Ordnance Service wishes continued. If this is done there can be no doubt that all of the Society's work and workers will be so abreast of developments and so broad in accomplishments that in another emergency it will be able to render just as much effective service as that for which it has been awarded.

The Society needs the ideas and the services of first rank workers. These should be blended into aggressive eye-to-the-future groups. These in turn should be fused into a Society knowing the past and present and able properly to foretell the future of the many engineering materials in its field, and having the "selling" ability to place its specifications and methods of testing in wide circulation. If the Society, so constituted, will continue in the future with an even broader viewpoint than in the past, it will meet the wishes of the Ordnance Department and one of the outstanding purposes of the award. In meeting these wishes it will also meet the aims and the needs of its members and adequately serve the public for which it exists.

PRESIDENT

1945 Nominating Committee

IN ACCORDANCE with the By-laws, providing that the Executive Committee shall select a nominating committee for officers at its October quarterly meeting, the Executive Committee has considered the report of the tellers, A. F. Burbidge, Principal Testing Engineer, Philadelphia Department of Public Works, and J. L. Eigenbrot, Assistant to the President, Stonega Coke and Coal Co., on

the recommendation of members for appointees on the nominating committee and selected the following committee and alternates:

MEMBERS	ALTERNATES
L. S. Marsh, Inland Steel Co.	T. G. Stitt, Pittsburgh Steel Co.
B. L. Whittier, Mt. Vernon-Woodberry Mills, Inc.	F. B. Bonnet, American Viscose Corp.
C. E. Heussner, Chrysler Corp.	L. A. Danse, General Motors Corp.
J. C. Moore, Sinclair Refining Co.	P. L. Lotz, Socony-Vacuum Oil Co., Inc.
M. H. Bigelow, Chemical Warfare Service, USA	G. M. Kline, National Bureau of Standards
F. H. Jackson, Public Roads Administration, Federal Works Agency	C. E. Wuerple, Corps of Engineers, USA

The three immediate past-presidents, G. E. F. Lundell, H. J. Ball, and Dean Harvey, serve as *ex-officio* members of the 1945 Nominating Committee. The committee will meet in March and make nominations for each office—president, vice-president, and five Members of the Executive Committee. The selections by the nominating committee will be announced to the members in the ASTM BULLETIN prior to transmission of official ballots.

Buffalo Selected as Annual Meeting City

Apparatus Exhibit to Be Held This Year

By ACTION at its October Meeting, the Executive Committee has decided to hold the Society's 1945 (Forty-eighth) Annual Meeting in Buffalo during the week beginning June 18. The technical sessions and meetings will be concentrated in the Hotel Statler, but cooperating with the Statler in connection with room reservations are two other leading hotels—the Lafayette and the Hotel Buffalo. Contacts with hotel managers have resulted in guarantees to provide sufficient sleeping accommodations for the members and committee people.

Apparatus Exhibit

The Society will also sponsor during the Annual Meeting its Seventh Exhibit of Testing Apparatus and Related Equipment, renewing again this interesting feature which began in 1931 and carried through 1941 in odd-numbered years. Because of the war situation and the tremendous need for scientific instruments, the exhibit was not held in 1943.

In the meanwhile there have been many notable developments in the field of testing and the use of instruments in research and allied fields, and the exhibit will afford leading manufacturers and distributors of equipment an opportunity to stress to the members and those attending the Annual Meeting new and improved features. As in previous exhibits, a number of scientific and educational displays will be planned, stressing the importance of instrumentation in the field of materials.

Annual Meeting Notes

In connection with facilities for holding the Annual Meeting, the possibilities of several industrial centers were thoroughly investigated and this year Buffalo seemed a logical choice. Further, no annual meeting has been held there and many A.S.T.M. members and committee

Schedule of A. S. T. M. Meetings

DATE	COMMITTEE	PLACE
January 15, 16.....	D-2 on Petroleum Products and Lubricants	Detroit, Mich.
January 17.....	New York District—Petroleum and Its Modern Derivatives.....	Engineering Societies Bldg., New York
January 19	Chicago District....	Engineers Club, Chicago, Ill.
January 22.....	Philadelphia District—Symposium on Magnetic Particle Testing.....	Benjamin Franklin Hotel Philadelphia, Pa.
January 22, 23.....	Executive Committee.....	Headquarters, Philadelphia, Pa.
February 26—March 2.....	SPRING MEETING AND COMMITTEE WEEK....	Hotel William Penn, Pittsburgh, Pa.
March 7, 8, 9.....	D-13 on Textile Materials.....	Park Central Hotel New York, N. Y.
June 18–22.....	FORTY-EIGHTH ANNUAL MEETING.....	Statler Hotel, Buffalo, N. Y.

people are located in the Western New York-Ontario District area. There is a District Committee functioning in this area headed by B. L. McCarthy, Wickwire Spencer Steel Co.—this group will have an important part in Annual Meeting arrangements and activities.

Offers of Meeting Papers Requested by February 1

COMMITTEE E-6 on Papers and Publications is extending to all materials and testing engineers the customary invitation to offer papers on subjects relating to the properties and testing of engineering materials for presentation at the 1945 Annual Meeting in Buffalo.

It is most important this year that the program of our Annual Meeting be developed at an early date so that transportation and hotel reservations may be made well in advance. Further, the Annual Meeting starting on June 18, is a full week earlier than the normal dates. Also, in order that as many as possible of the technical papers and committee reports can be preprinted in advance of the meeting, it is desirable that all offers for papers be received early so that final acceptance can be made and the typesetting started at an early date. Committee E-6 has, therefore, fixed February 1 as the limiting date for receipt of offers but members who may be considering the submission of a paper are urged to send their offers to A.S.T.M. Headquarters *as soon as possible*. Suitable blanks which should be used in sending the necessary information with respect to the offer of a paper can be obtained from the Society offices. Each offer must be accompanied by a summary of the proposed paper in such detail that its scope is clear and also to point out features that in the author's opinion make the paper a desirable one for presentation and discussion.

Outstanding Symposium on Stress-Corrosion Cracking

Joint A.S.T.M.-A.I.M.E. Publication to be Issued

SUSTAINED INTEREST, lively and constructive discussion, and a program that moved with timetable precision featured the A.S.T.M.-A.I.M.E. Joint Symposium on Stress-Corrosion Cracking held at the Benjamin Franklin Hotel, Philadelphia, November 29, 30, and December 1. Some 350 members of the two societies and guests attended the symposium which followed closely the preliminary program published in the October issue of the BULLETIN. Although some came for only part of the symposium, the average attendance at each of the eight sessions was well over 200.

One of the high spots of the meeting was the dinner on Wednesday evening, sponsored by the Philadelphia A.S.T.M. District Committee and the local section of A.I.M.E. At this dinner, N. L. Mochel, Westinghouse Electric and Mfg. Co., served as toastmaster. At the speakers' table, in addition to Ralph Kelly, President of The Baldwin Locomotive Works, and Edward H. Dix, Jr., Assistant Director of Research and Chief Metallurgist, Aluminum Research Laboratories, who were the principal speakers, were a number of officers of the two societies including J. R. Townsend, Vice-President of A.S.T.M., J. L. Christie, Vice-President of A.I.M.E., A. B. Parsons, Secretary of A.I.M.E., C. L. Warwick, Secretary-Treasurer of A.S.T.M., E. E. Schumacher, Vice-Chairman of the Institute of Metals Division of A.I.M.E., George Harnden, Chairman of A.S.T.M. Committee B-5, and L. E. Ekholm and H. B. Allen, Chairmen, respectively, of the local A.S.T.M. and A.I.M.E. groups.

Toastmaster Mochel introduced the members of the committee which had directed the symposium, and then Mr. Warwick spoke briefly pointing out the pleasure it was for A.S.T.M. to cooperate with A.I.M.E. in sponsoring a program of such timely and widespread interest.

Mr. Kelly, who spoke on "How Do Things Look Today and for the Future," answered the two parts of the question in a definitely optimistic vein, feeling that heavy and other industries should have much activity for several years after the war. He expressed no great alarm generally over problems of reconversion, pointing out that American industry had lived through many trying periods in connection with war production problems, materials supply, etc., so reconversion should not have too many terrors. He was optimistic from the employment standpoint, stressing the large number of service industries which will again employ large numbers of our people from the Armed Forces and others who will transfer their activities from war to peace.

The technical address of the evening, "A Critical Discussion of Stress-Corrosion Cracking," was given by Mr. Dix, who gave his hearers a comprehensive and enlightening review of the problem and the status of our present knowledge of the subject.

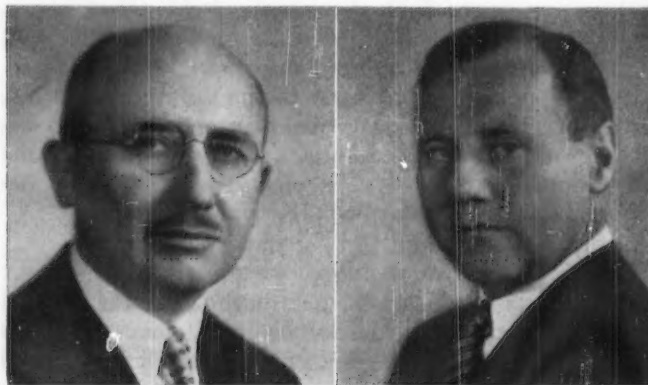
"It is a matter of general experience," he said, "that stress-corrosion cracking in service results from tensile stresses at the surface, usually of considerable magnitude, acting for prolonged periods of time. For the many years that stress-corrosion cracking was somewhat of a mystery

and laboratory curiosity and generally recognized in only a few commercial products, it is probable that many stress-corrosion cracking failures went unrecognized and were diagnosed as simple mechanical failures from overloading, fatigue, or impact. With the coming of a more universal recognition of the general susceptibility to stress-corrosion cracking of many commercially useful materials, metallurgists and engineers have become stress-corrosion-cracking conscious. As so often happens with the pendulum swing, stress-corrosion cracking is now being suspected when failures are, in reality, from simple mechanical causes. Also many corrosion investigators are using the term "stress corrosion" loosely when intergranular corrosion or other localized attack is found after exposure to corrosive environments.

"Research on stress-corrosion cracking should have two principal objectives. First, to devise ways and means in which an otherwise useful metal or alloy can be employed in a specific application without the occurrence of stress-corrosion cracking. Second, to develop a theoretical understanding of the mechanism of stress-corrosion cracking and from this theoretical conception, to devise metallurgical methods by which immunity to stress-corrosion cracking under any conditions can be obtained."

The first three sessions of the symposium dealt with the subject of stress-corrosion cracking of brass and included six papers presented by various technicians from the Frankford Arsenal and three from the laboratories of the New Jersey Zinc Co., as outlined in the program printed in the October BULLETIN. An added paper arousing considerable interest was one on the eddy current method of inspection of shell cases by J. E. Dinger of the Naval Research Laboratory. The relative merits of ammonia and mercury tests for stress cracking susceptibility received a thorough discussion. While the latter is the time-honored test, it was pointed out that the evidence presented to show the role of ammonia and nitrogen compounds in service failures of ammunition justifies increasing reliance on the ammonia test, which, in spite of its complexity, is much more sensitive and more nearly reproduces service conditions.

Test methods being used for light metals and alloys were discussed at the Thursday afternoon and evening sessions. The latter was featured by the presentation of the papers contributed by the British authors representing the Institute of Metals and the Iron and Steel Institute. As neither of the British authors was able



E. H. Dix

Ralph Kelly

to be present, the paper by George and Chalmers was presented by W. H. Runham of Lloyd's Register of Shipping, and the paper by Champion was ably analyzed and explained by Louis W. Kempf of the Aluminum Company of America.

The Friday morning session on steel was unique in that it is probably the first time the problem of stress-corrosion cracking of steels had ever been generally presented and discussed by such a group of authorities on the subject. The Friday afternoon session, dealing with miscellaneous metals, rounded out the program and demonstrated that, under proper conditions of stress and corrosive environment, there is hardly a metal known which is not susceptible to some type of stress-corrosion cracking. An added paper at this session, by John L. Christie, covered a case of stress-corrosion cracking of a low carat gold alloy. To conclude the symposium, Co-Chairman E. A. Anderson of the New Jersey Zinc Co. gave a brief summary of the

*Closing date for receipt of discussion of these papers—
February 1, 1945*

proceedings, which will be considerably amplified to form a closing paper for the published symposium. This publication, which will be available in the spring, will contain all the papers and discussion and undoubtedly will be recognized as an outstanding reference on the subject for many years to come.

Mr. Anderson also pointed out that there were a number of other papers on the subject of stress-corrosion cracking which for security reasons during the war had not been included in the symposium.

With a word of thanks to the authors and the discussers for their contributions to the symposium and to the audience in general for their continued interest throughout the sessions, Co-Chairman Carter S. Cole of A.S.T.M. adjourned the symposium.

DISTRICT COMMITTEE AND MEETING NOTES

Petroleum and Some of Its Modern Derivatives to be Covered at New York Meeting

UNDER THE AUSPICES of the New York District Committee an interesting meeting is being planned for Wednesday, January 17, involving the general subject—Petroleum and Some of Its Modern Derivatives. The meeting will be held in the Auditorium, Room 501, of the Engineers Society Building, 29 West 39th Street, beginning promptly at 8 p.m.

The main feature of the meeting will be presented by Dr. J. C. Dean of the Socony-Vacuum Oil Co., Inc., on the subject "Processing Materials from Petroleum." He has carried out a great deal of work in this field and has some very interesting material to present not only in his address but also through demonstration with certain samples and illustrations.

There are scores of these so-called "Process Products" now used in hundreds of important applications. The main groups from which the products stem include: microcrystalline waxes, wax emulsions, petrolatums, miscellaneous paper mill products, textile oils, metallic naphthenates, miscellaneous process oils.

Some of the fields where the products are being used include textiles, paper, plastics, rubber, pottery, paint, tree sprays, cordage and fabric preservatives, moisture-proofing agents, and anti-rust compounds—also insecticides, larvacides, electrical apparatus, food packages and cleaners.

It is interesting to note that about 60 years ago the three derivatives of crude oil were kerosine, gasoline, and black oil. Today, they are numbered in the hundreds.

Dr. Dean's talk will be followed by the motion picture—The Story of the "Big Inch"—presented by G. M. McComb, Barrett Division of the Allied Chemical & Dye Corp. This film will be presented in its most recent form by means of a new projector which provides detailed pictures of the various processes and products involved in this huge undertaking, successfully completed during the War Emergency.

Myron Park Davis, Chairman of the District Commit-

tee, will open the meeting introducing Dr. T. G. Delbridge, Atlantic Refining Co., Past-President of the Society, who will serve as Technical Chairman. The program has been arranged by a committee consisting of Messrs. R. M. Wilhelm, Chairman, with Lawford Fry, G. O. Hiers, W. J. Krefeld, and E. A. Snyder.

The Society's Vice-President, J. R. Townsend and other members of the Executive Committee as well as the New York District Committee will be present to greet the members. All members of the Society and their associates concerned with this important subject are cordially invited to be present. Those in the New York District will be receiving further details of the meeting.

Well-Attended Pittsburgh Meeting on Cements and Glass

TWO INTERESTING addresses, one by President P. H. Bates, the second by F. C. Flint, featured the meeting on October 26 at the Mellon Institute in Pittsburgh, sponsored by the Pittsburgh District Committee. Some 150 members and visitors attended, including many from out of the city. The Pittsburgh section of the American Ceramic Society participated in the meeting with a goodly number of their members present.

In his talk on "Portland Cement and the Distinctive Characteristics of Five Different Standardized Types," Mr. Bates who has been chairman for many years of Committee C-1 on Cement gave a detailed picture of the developments, requirements, and application of cement, stressing the importance of the five different types that are covered in A.S.T.M. standards.

Mr. Flint who is Chief Chemist and Director of Research, Hazel-Atlas Glass Co. and very active in A.S.T.M. work titled his talk "Glass—A Summary of Its Development as an Art and as a Science." It is planned to publish a major portion of his paper in the ASTM BULLETIN, probably the January number.

Thomas Spooner, Chairman of the Pittsburgh District Committee, presided, introducing the speakers and also calling on Secretary-Treasurer C. L. Warwick for a few remarks. Committee Secretary P. G. McVetty cooperated with Mr. Spooner in various arrangements for the meeting, and other District members also aided. As an-

nounced elsewhere in the BULLETIN, the District is taking a leading part in connection with the A.S.T.M. Spring Meeting to be held in Pittsburgh, Wednesday, February 28, with a series of technical papers comprising a symposium on corrosion prevention covering various types of treatments—metallic coatings, organic materials, etc.

Detroit District Holds Tenth Annual Meeting

THE TENTH TECHNICAL Session arranged by the Detroit District Committee was held on November 21, with three papers on the Life Testing of Materials.

Two hundred thirty persons were present at the dinner and about 350 at the program following. Martin Casticum, chairman of the Detroit District Committee, presided. C. H. Fellows was in charge of dinner arrangements, Messrs. W. C. Du Comb and F. P. Zimmerli of publicity, A. C. Eichenlaub of display, and V. M. Darsey, secretary of the Detroit District Committee, of other arrangements.

Both President P. H. Bates and Secretary-Treasurer C. L. Warwick attended the meeting and spoke briefly following the dinner. President Bates spoke of the large publication program of the Society, and of his hope that all papers can be published as received through the year, possibly in the BULLETIN and not solely in the *Proceedings*. He said too that, in the plans being made for the future activities of the Society, consideration is being given to placing still greater emphasis on District Committee Activities. Mr. Warwick discussed the status of the new Book of Standards and outlined the activities and accomplishments of some of the special committees of the Society. One of these committees is engaged, he said, in a study of what place the Society ought to take in the future with respect to specifications and tests for ultimate consumer goods, and another is studying the subject of the testing of parts and assemblies.

The three papers presented at the technical session were these:¹

Fatigue Testing of Tire Cord, by Dr. W. E. Roseveare, Research Supervisor, E. I. du Pont de Nemours and Co., Inc., Richmond, Va.

Life Testing of Metals, by Mr. R. E. Peterson, Manager, Mechanical Division, Westinghouse Research Laboratories, East Pittsburgh, Pa.

Life Testing of Lubricating Oils, by Mr. H. C. Mougey, Technical Director, General Motors Research Laboratories, Detroit, Mich.

In introducing Dr. Roseveare, Chairman Casticum remarked that in tires it is the cord which carries the load and gives resistance to bruising. Tire cord is thus an engineering material, and one for which A.S.T.M. has tests and tolerances. Mr. Casticum said 400,000,000 lb. of tire cord will be used this year, of which about one-half will be rayon.

Dr. Roseveare, in his paper on "Fatigue Testing of Tire Cord," discussed the general theory of fatigue and the behavior of rayon tire cord in various laboratory fatigue tests. Rate of fatigue is determined, he said, by the total magnitude of the cyclic strain and of the minimum strain, and by the period of the cycle, the temperature, the humidity, and the presence of chemically reactive

materials. The fatigue life of a single filament measures its resistance to cyclic stresses along the fiber axis; but, when a number of filaments are incorporated into a twisted cord, other possibilities for failure are introduced by the interaction between filaments. A rayon cord fatigued to incipient failure shows a large number of broken filaments all along the cord. The optimum cord construction for one type of rayon yarn is thus not necessarily the best construction for another type having different properties. In fatigue life, rayon is intermediate between materials that are very hard and those that are ductile. Metals, plastics, elastomers, and fibers have in their fatigue behaviors similarities suggesting progressive fracture as a common basic mechanism for all fatigue failures.

Dr. Roseveare's paper was discussed by Dr. A. W. Bull and Mr. H. S. Howe of the U. S. Rubber Co. Dr. Bull pointed to the severe conditions used in some of the laboratory tests as compared with service, and Mr. Howe discussed the importance of creep in the failure of fibers. The factor of creep, replied Dr. Roseveare, is one which, although important, cannot yet be properly isolated.

Mr. Peterson, in the introduction to his paper on Life Testing of Metals, said that he should like in his case to broaden the subject to the relationship between life testing and behavior in service. He gave several illustrations of the accelerated life testing of fabricated equipment, such, for instance, as the door of a domestic refrigerator tested in place. By such means, most questions of durability can be answered, but corrosion is an exception. He cited one instance in which the life of a part was increased sixfold through information gained in such life testing. In the testing of metals before fabrication, he divided the influencing elements into two groups: A, quantitative, consisting of fatigue and creep; and B, qualitative, consisting of wear, corrosion, and repeated impact. In the case of the qualitative factors, life testing is usually necessary, as the basic elements cannot be adequately calculated. But in the case of the factors listed



V. M. Darsey,
Secretary, Detroit
District Committee.

Photographs of other
officers appeared in a
previous BULLETIN

¹ It is hoped to publish these three papers in a forthcoming issue of the BULLETIN.

as quantitative, Mr. Peterson hoped that as knowledge increases life testing of parts will need to be used only as a check. But at present life testing, field tests, laboratory tests of conventional specimens, stress analysis and studies of mechanics of materials, all have a place in the overall picture, he said. And, if we wish to make the most effective progress in basic design practice, we should plan our work so that the results obtained in these fields can be correlated in a fundamental manner.

Mr. Peterson's paper was discussed by Mr. E. W. Upham of the Chrysler Corporation and by Mr. J. O. Almen of the General Motors Research Laboratories. Mr. Upham presented a chart relating various factors in fatigue testing which he had found helpful. Mr. Almen said that experience has shown that, at least in the present state of knowledge of materials, design to final dimensions from the results of laboratory tests of metals is not possible when it is necessary to use them at maximum effectiveness, as is so in automobile parts.

In presenting his paper on "Life Testing of Lubricating Oils," Mr. Mougey made effective use of supplementary illustrations in bringing out his point that "The proof of the pudding is in the eating." The conventional laboratory tests for lubricating oils, such as viscosity, flash, fire, etc., are of value as identification tests and for such purposes as checking uniformity of shipments and controlling refinery processes. And, in certain cases, there is some correlation between these tests and performance in service. But, in the main, "they do not demonstrate the value of oil under practical conditions." By a combination of laboratory tests, identification tests, and engine tests under controlled conditions it is possible, however,

to predict how an oil will perform in actual service. The five engine tests employed in evaluating the service quality of heavy-duty lubricating oils for the Army and the Navy were described briefly, and the applicability of each explained. Each test measures certain properties of the oil, such as detergency, load-carrying capacity, resistance to oxidation, and tendency to cause varnish and ring sticking. As these engine tests are more severe than the operating conditions in most actual service, oils which pass the tests will, as experience has shown, usually be satisfactory in service.

Mr. Mougey's paper was discussed by Mr. Harry L. Moir, Pure Oil Co., Chicago, and by Mr. F. G. Shoemaker, Detroit Diesel Engine Division of General Motors. Mr. Moir said that in the future there will be a need for lubricating oils designed for individual cases rather than all oils being pooled together into an all-embracing specification. He said also that, in the engine testing of lubricating oils, some provision should be made for the testing of fuels as well. Mr. Shoemaker gave a brief history of the 500-hour diesel oil test. He said also that there is no limit to the demand for output or performance in engines, and that at high outputs engine life is a function of the quality of the lubricating oil.

This very successful meeting was held at the beautiful Rackham Educational Memorial, headquarters of the Engineering Society of Detroit and of the various societies affiliated with it, of which the Detroit District of A.S.T.M. is one. Through the kindness of Messrs. J. L. McCloud and J. S. Laird of the Ford Motor Co., the three speakers, together with Messrs. Bates, Warwick, Casticum, and Putnam, made a trip through the Willow Run Bomber Plant on the day of the meeting.

Engineering Panels to Feature New York Meeting

UNDER THE auspices of the Engineering Societies Committee on War Production in New York City, there is to be held at the Hotel Commodore on January 30 a series of panel discussions dealing with problems of much interest to many A.S.T.M. members. The tentative program for this series of sessions follows. Further details will be furnished the members of the cooperating societies in a direct mailing early in January.

CONFERENCE ON WAR PRODUCTION AND RECONVERSION
January 30, 1945

Hotel Commodore New York City

2:30 p.m.

- Panel 1. Safety Engineering
- 2. Metals Industries

4:30 p.m.

- Panel 3. Engineering in Small Plants
- 4. Post-War Construction
- 5. Chemical Industries

6:30 p.m. Dinner

8:30 p.m.

- Panel 6. Management and Manpower
- 7. Electronic Applications
- 8. Materials Utilization
- 9. Economic Development

As is customary in these war conferences, there will be a dinner, beginning at 6:30 p.m. sharp, tickets for which are

\$5. This includes all expenses. Some outstanding speaker will deliver an appropriate address and there will be other features. Tickets can be obtained from Mr. H. R. Kessler, Eng. Soc. Committee on War Production, Room 1100, 29 West 39th St., New York 18, N. Y. Checks should be made payable to "A.S.M.E. Metropolitan Section." All dinner tickets will be mailed and the seating at tables will be assigned. Ten tickets reserve a table.

Mr. Myron Park Davis, Otis Elevator Co., Chairman of the A.S.T.M. New York District Committee, is participating in the plans for the meeting. He was recently re-elected secretary of the Engineering Societies Committee. Other A.S.T.M. members also are participating.

Chicago Meeting—January 26

UNDER THE AUSPICES of the Chicago District Committee, a dinner meeting is to be held at the Chicago Engineers' Club on January 26, 1945 featuring talks by the Society's President, P. H. Bates, National Bureau of Standards, describing some of the activities at the Bureau which are of much interest to many members of the Society, and by J. C. Dean, Engineer, Process Products Unit, Socony-Vacuum Oil Co., Inc., who will present his technical talk covering "Processing Materials from Petroleum." All A.S.T.M. members and friends, are cordially invited to attend. Further details will be sent members and committee people in the Chicago area.

Meeting of Committee on Wires for Electrical Conductors

AT THE ALL-day meeting of Committee B-1 on Copper and Copper-Alloy Wires for Electrical Conductors held in New York City on November 20, with Chairman J. H. Foote, Supervising Engineer, the Commonwealth and Southern Corp., presiding, a number of actions were taken which eventually will result in modifications in the various specifications and test procedures for which the committee is responsible. Some 30 members of the committee were present at the meeting.

The recommendation affecting the specifications for soft or annealed copper wire, B 3-41 and for tinned wire, B 33-39 to delete the requirements for tensile strengths for all diameters 0.021 and smaller was approved. In the latter standard and also the emergency specification covering lead-coated and lead-alloy-coated copper wire, ES 1a, there will be added a statement that if tests of coatings are required, they are to be on wires prior to subsequent processing. This led to a rather lengthy discussion for testing the adherence of coatings. Resulting from this are recommendations which would modify the section on mechanical tests in the standard B 33, to provide for definite requirements for (1) length, (2) preparation of sample, (3) wrapping procedure, (4) immersion test, (5) examination, and (6) retest. The committee also decided to have a special subcommittee draft a specific test method for wire coatings, with the object of having this issued as a tentative standard.

In the standard, B 48, covering soft rectangular and square copper wire the resistivity is to be changed from the present maximum of 891.58 ohms to 875.20. Concerning bending properties in B 48, the present requirements are to be modified with details to be developed and distributed to the committee for letter ballot along with the other items.

The committee plans to refer to the Society next year for adoption as standard three tentative specifications, B 172, rope-lay-stranded copper conductors having bunch-stranded members; B 173, rope-lay-stranded copper conductors having concentric-stranded members, B 174, bunch-stranded copper conductors. However, in the latter specification, the table covering maximum length of lay is to be amplified.

Discussion on whether the scope and jurisdiction of the committee should be expanded to include copperweld, aluminum and other conductors led to the appointment of a small section to develop a consensus and recommend changes in by-laws. This matter eventually will be referred to the Society.



Officers of Committee A-6 on Magnetic Properties. From left to right; Thomas Spooner, Chairman; P. H. Dike, Vice-Chairman; and R. L. Sanford, Secretary.

Report on Meeting of Committee D-9 on Electrical Insulating Materials

AT THE WELL-attended series of meetings of Committee D-9 on Electrical Insulating Materials at the Claridge Hotel, Atlantic City, N. J., on October 24 and 25, the subcommittees reported interesting accounts of progress on numerous subjects. Myron Park Davis, committee chairman, presided at the meetings, with numerous matters handled by committee secretary W. A. Zinzow.

In the work on insulating varnishes, lacquers, etc., revisions are being developed in the oil resistance test covered in the Standard Methods D 115 to describe in greater detail observations that must be made in determining this property. The work on deep-drying varnishes continues with endeavors to develop procedures for determining the penetrating qualities, internal or deep drying, and bonding strength of varnishes used for treating coils of all descriptions. This subcommittee is studying dielectric strength tests of varnish films and is drafting methods for set time of thermosetting resins.

A major project in the subcommittee on molded materials is complete revision of the widely used Methods of Testing, D 48. The committee will recommend the adoption as standard of the Tentative Specifications for Molds for Test Specimens, D 647. Proposed standard requirements for vinyl chloride and vinyl acetate tubing are being developed along with procedures for evaluating certain of their properties. A new grade of material which could be used where odor, taste, or tarnishing effects are objectionable is to be added to the phenolic molding compound specifications, D 700.

A new flexural test of plastics, D 790, was approved at the A.S.T.M. Annual Meeting in which some proposed changes have been developed in the work of the D-9 group concerned with plates, tubes, and rods. Other activities include bonding strength, arc resistance test method, bursting strength of tubes, and a review of the electrical properties as covered in current specifications on plastics as issued by Committee D-20. The subcommittee in charge has a number of investigations and round-robin tests under way involving various properties and products.

The work on liquid insulation concerns a number of problems including reorganization of test methods now appearing in Methods D 117, also further work on sampling. Perhaps of predominant interest are the activities involving the sludge test investigations and other characteristics of transformer oils in which a number of utilities are cooperating, notably the Detroit Edison Co., which is



Officers of Committee D-17 on Naval Stores. From left to right, V. E. Grotlich, Chairman; E. V. Romaine, Vice-Chairman; and W. A. Kirklin, Secretary.

Comments on Liquid Insulation Tests

THE COMMITTEE D-9 Subcommittee on Liquid Insulation is anxious that the proposed methods published for information and comment in the 1944 Annual Report of Committee D-9 covering gas content of insulating oil will result in trials and sufficient experience to justify approval as a tentative standard. These methods which apply to oils for use in capacitors and paper-insulated lead-covered electric cables of the oil-filled type comprise a referee and a routine test which are carefully delineated in the methods. There is discussion on errors which may occur in the routine methods. In addition to publication in the 1944 *Proceedings*, these methods will be included in the Special Compilation of Standards on Electrical Insulating Materials.

making available certain banks of transformers in which different types of oils will be tested.

Activities on ceramic products include further consideration of the emergency standards for communication and pin type lime glass insulators, ES-41, so that they can be recommended as regular standards. These were issued on August 28. There is considerable interest in steatite with work on test methods and specifications.

Concerning insulating fabrics, there is considerable activity involving revisions to make various requirements completely suitable for the glass types of fabrics. Also involved are changes in sampling requirements and in the Methods D 295 to test cloths and tapes after stretching at a uniform prescribed rate.

In the work on insulating papers, correlation is involved between Committees D-6 on Paper and Paper Products and D-9. Round-robin tests are being continued in connection with the pH values and the subcommittee is getting information with respect to tensile strength and edge strength tearing methods.

Conditioning procedures to be used for testing insulating materials are now being very carefully reviewed and a complete revision of the Methods D 618 is expected. The various electrical tests of Subcommittee XII covering insulation resistance, power factor, dielectric constant, etc., are being reviewed and reorganized. The committee on mechanical tests is studying the compression test as applied to various types of materials.

Meeting of Committee on Plastics

A NUMBER of important recommendations were approved at the well-attended meetings of Committee D-20 on Plastics and its subgroups in Atlantic City,



Officers of Committee A-10 on Iron-Chromium-Nickel and Related Alloys. From left to right, Jerome Strauss, Chairman; H. L. Maxwell, Vice-Chairman; and H. D. Newell, Secretary.

October 26 and 27. It is planned to include in the January *BULLETIN* a rather detailed news account of this meeting, similar in nature to the article in this issue on the work of Committee D-9 on Electrical Insulating Materials, the meetings of which preceded by two days the D-20 meetings. It has been customary for these two committees to have their sessions on successive days.

Committee D-13 on Textiles Has Very Productive Meetings

THE SERIES of meetings of Committee D-13 on Textile Materials held at the Park Central Hotel, New York City, October 18 to 20, inclusive, were not only well attended but were extremely productive of results in the committee's standardization and research program. The total registration of 233 indicates the interest in these meetings; of this number, 171 were committee members. There were upwards of 25 separate meetings on the three days, including a most interesting Papers Session. (Further information will be furnished concerning the possible publication of the various papers presented.)

Following the dinner, Dr. Harold DeWitt Smith, A. M. Tenney Associates, Inc., again presented his 1944 A.S.T.M. Marburg Lecture, in condensed form. This lecture covering "Textile Fibers—An Engineering Approach to an Understanding of Their Properties and Utilization" is in course of publication by the Society.

The following papers were given in the technical session:

Tomorrow's Textiles—Yesterday's Test Methods—J. B. Goldberg, J. P. Stevens & Co.

Factors Influencing the Breaking Strength of Army and Navy Fabrics—Dr. Werner von Bergen, Forstmann Woolen Co. (This paper was presented at the Annual Meeting of the Society and will appear in the *Proceedings*.)

A Suggested Method for the Thorough Testing of Antiseptic Fabrics—Louis C. Barail, U. S. Testing Co.

There were several additional papers given in some of the subcommittee meetings covering problems of specific interest to the indicated groups. The subjects covered were as follows:

Subcommittee A-1 (Cotton), Section I (Cotton)—The Importance of Various Fiber Properties in American Upland Cotton in Terms of Yarn Strength—R. W. Webb, Cotton Branch, War Food Administration.

Subcommittee A-1, Section IV (Tire Fabrics)—Fatigue Testing of Rayon Tire Cord—Lewis Larrick, B. F. Goodrich Co.

Subcommittee B-5 (Sampling Presentation and Interpretation of Data)—The Preparation of Specifications—Lt. Col. F. M. Steadman, Philadelphia Q.M. Depot; Ap-



Officers of Committee D-6 on Paper and Paper Products. From left to right, L. S. Reid, Chairman; M. A. Krimmel, Vice-Chairman; and G. H. Harnden, Secretary.

plication of Control Charts to Indigo Washing—John Hintermaier, Forstmann Woolen Co; Quality Control in the Manufacture of Nylon Shroud Lines—J. K. Frederick, Jr., Textron Incorporated.

Standardization and Research Work

Among the items considered in the various subcommittee meetings and at the main D-13 session were the following—many of these matters will of course be formally recommended to the Society in the Committee's 1945 report, following approval by letter ballot:

1. Revisions of General Methods of Testing Cotton Fibers (D 414-40 T) when incorporated will improve certain aspects of the methods, and there will be added new tests for fiber length and strength.
2. Methods of Testing and Tolerances for Tire Cord, Woven and on Cones (D 179-42) will be revised to cover cotton cords only, and there will be drafted a separate standard for rayon cords.
3. The wool committee is continuing its studies on fineness of fleeces of 44's grade and also, improvement of fiber fineness measuring technique. A new cross-sectioning device capable of holding a full sliver of top was demonstrated.
4. Methods of test are being developed for the following properties of felt: air resistance of filter felts; flame resistance; hardness; and water repellency. Specifications for mechanical and sheet felts are being developed.
5. Proposed revisions of the Methods of Testing and Tolerances for Woolen Yarns (D 403-44) and for Worsted Yarns (D 404-44) would provide a standard moisture content as a basis for weight for woolen and worsted hand-knitting yarns. Data are being gathered on determining statistically the number of tests to be made on the various properties of woolen and worsted yarns. The adoption of the Grex system for numbering these yarns is being considered.
6. An interlaboratory program will be started on pile floor coverings to develop methods of test for light fastness, crocking, spotting, shrinkage, bleeding, and soiling, with a view to recommending them for inclusion in a revision of Commercial Standard CS 59-44. Methods of testing for luxury characteristics of pile floor covering, such as pile density and resiliency, are being studied. In connection with the evaluation of properties very important to the consumer or with which the consumer is much concerned, reference might be made to the paper on "The Interpretation of Laboratory Tests as Quality Indices in Textiles" by A. G. Ashcroft, Director of Research, Alexander Smith and Sons Carpet Co., appearing in this BULLETIN.
7. An interlaboratory test of breaking strength of woolen and worsted fabrics will be conducted. The data obtained will be statistically analyzed to determine the number of tests that should be made.
8. A study is being made of the tentative specifications for woven asbestos cloth (D 677), particularly on the possibilities of eliminating certain inconsistencies in the physical property requirements. Methods for the determination of iron in asbestos are being studied. Requirements on procedures are given in the Standard Specifications D 375-44 covering asbestos roving for electrical purposes.

9. Methods of testing for extractable matter such as oils, fats, waxes, tar, etc., are being studied as they are incorporated in the several standards for jute, for example, Methods D 541—single jute yarn, Methods D 681—rove and plied yarn for electrical and packing purposes, Methods D 738—rope, and Methods D 739—spun, twisted, or braided products made from flax, hemp, and ramie.

10. Work is in progress on the serviceability of bleached wide cotton sheeting. It is proposed to add specifications for blanket fabrics containing rayon to the Tentative Specifications D 576, covering all wool, all cotton, and wool and cotton blanketing.

11. Methods are under development for determining yarn numbers in woven fabrics, redwood bark fiber in wool fabrics, and for distinguishing between saponified acetate and viscose rayons. A proposed revision of methods of testing and tolerances for knit goods, D231-39, would eliminate the requirement of a special extraction apparatus. The proposed methods for evaluation of properties related to "hand" are being prepared for submission as tentative. A special committee will study wear test (abrasion) methods approaching the problem from the viewpoint of the end use of the commodity.

12. An exhaustive study will be made of testing machine clamps and jaws by a special committee with particular reference to their adaptability in testing various types of material.

13. Efforts are being continued to bring about an agreement with the British Committee on Definitions on a suitable generic term for all man-made fibers. A tentative agreement has been reached with the Federal Trade Commission for the use of "protan" as a generic term for filaments made from natural proteins. The Grex system will be proposed as a Tentative Recommended Practice for Determining Yarn Numbers.

14. A definite program on accelerated aging tests for cotton has been set up and work on it will start in the near future. The cooperative tests on resistance of textiles to insect pests are being continued with particular reference to better standardization of light for examination of extent of damage. A thorough study of the identification of resin finishes on textiles has been started.

15. The close relationship between the American Association of Textile Chemists and Colorists and the A.S.T.M. has resulted in cooperative programs carried out in conjunction with their member laboratories. These are: (a) resistance of textiles to microorganisms involving several organisms and types of textiles; (b) colorfastness to washing and laundering involving repeated washings in commercial and home laundries to get the effect of abrasion; (c) development of set of standards for direct comparison against test specimens in determining lightfastness.

16. Two important special committees are actively at work—one on "Preparation of Standards" is developing an outline of steps to be taken in writing specifications, and the other known as the "Specifications Review Committee" is assisting the "A" committees (cotton, wool, rayon, asbestos, etc.) in the collection and analysis of data to determine the proper number of tests for the evaluation of properties.

These meetings in New York were under the general direction of Committee D-13's Chairman, Professor H. J. Ball, Lowell Textile Institute, with the Secretary, W. H. Whitcomb.



Officers of Committee D-8 on Bituminous Waterproofing and Roofing Materials. From left to right, J. S. Miller, Chairman. E. H. Berger, Vice-Chairman; and Prevost Hubbard, Secretary.



Officers of Committee D-5 on Coal and Coke. From left to right, A. C. Fieldner, Chairman; O. O. Malleis, Vice-Chairman; and W. A. Selvig, Secretary.

New Officers of Standing Committees

IN ACCORDANCE with the Regulations Governing Standing Committees, officers of these technical groups are elected in the even numbered years. As a result of 1944 elections, a number of new officers have been selected to guide the work of the Society's committees, the names of the new officials appearing below. Terms of office are for two years.

Probably only one who has been a committee officer can fully appreciate the very extensive amount of work entailed in handling committee work, not only correspondence but conferences, meetings, and related matters.

Referring to the following list—in all cases where an office or a committee is not listed the former officers were honored by re-election.

NEW A.S.T.M. COMMITTEE OFFICERS

COMMITTEE A-1 ON STEEL—*Secretary*, R. J. Painter, American Society for Testing Materials, Philadelphia 2, Pa.

COMMITTEE A-2 ON WROUGHT IRON—*Vice-Chairman*, D. M. Stembel, Lockhart Iron and Steel Co., Pittsburgh 30, Pa.; *Secretary*, James Aston, A. M. Byers Co., Pittsburgh, Pa.

COMMITTEE A-3 ON CAST IRON—*Chairman*, J. T. MacKenzie, American Cast Iron Pipe Co., Birmingham 2, Ala.; *Vice-Chairman*, E. R. Young, Climax Molybdenum Co., Chicago 1, Ill.; *Secretary*, C. O. Burgess, Union Carbide and Carbon Research Laboratories, Inc., Niagara Falls, N. Y.

COMMITTEE A-7 ON MALLEABLE-IRON CASTINGS—*Chairman*, C. O. Burgess, Union Carbide and Carbon Research Laboratories, Inc., Niagara Falls, N. Y.; *Vice-Chairman*, W. A. Kennedy, Grinnell Co., Providence, R. I.

COMMITTEE B-1 ON COPPER AND COPPER-ALLOY WIRES FOR ELECTRICAL CONDUCTORS—*Secretary*, H. H. Stout, Jr., Ordnance Dept., U. S. Army; *Acting Secretary*, E. H. Kendall, Consumers Power Co., Jackson, Mich.

COMMITTEE B-2 ON NON-FERROUS METALS AND ALLOYS—*Honorary Chairman*, G. H. Clamer, The Ajax Metal Co., Philadelphia 23, Pa.; *Senior Vice-Chairman*, R. H. Leach, Handy & Harman, Bridgeport 9, Conn.; *Secretary*, G. Howard LeFevre, U. S. Smelting, Refining and Mining Co., New York 5, N. Y.

COMMITTEE B-3 ON CORROSION OF NON-FERROUS METALS AND ALLOYS—*Chairman*, H. S. Rawdon, National Bureau of Standards, Washington 25, D. C.; *Vice-Chairman*, R. W. Waring, Sperry Gyroscope Co., Inc., Brooklyn 1, N. Y.

COMMITTEE B-5 ON COPPER AND COPPER ALLOYS, CAST AND WROUGHT—*Chairman*, G. H. Harnden, Works Laboratory, General Electric Co., Schenectady 5, N. Y.; *First Vice-Chairman*, C. S. Cole, American Society for Testing Materials, Philadelphia 2, Pa.; *Second Vice-Chairman*, J. J. Kanter, Crane Co., Chicago 5, Ill.; *Secretary*, V. P. Weaver, The American Brass Co., Waterbury 88, Conn.

COMMITTEE B-7 ON LIGHT METALS AND ALLOYS, CAST AND WROUGHT—*Chairman*, D. L. Colwell, Office of Procurement and Material, Navy Dept., Washington, D. C.; *Vice-Chairman*, R. W. Waring, Sperry Gyroscope Co., Inc., Brooklyn 1, N. Y.; *Secretary*, J. J. Bowman, Aluminum Company of America, Pittsburgh 19, Pa.



Officers of Committee B-8 on Electrodeposited Metallic Coatings. From left to right, R. J. McKay, Chairman; E. A. Anderson, Vice-Chairman; and C. H. Sample, Secretary.

COMMITTEE C-4 ON CLAY PIPE—*Chairman*, J. C. Riedel, Board of Estimate, City of New York, New York 7, N. Y.; *Vice-Chairman*, D. G. Miller, U. S. Dept. of Agriculture, University of Minnesota, St. Paul 8, Minn.

COMMITTEE C-5 ON FIRE TESTS OF MATERIALS AND CONSTRUCTION—*Chairman*, S. H. Ingberg, National Bureau of Standards, Washington 25, D. C.; *Vice-Chairman*, A. L. Brown, Associated Factory Mutual Fire Insurance Cos., Boston 10, Mass.

COMMITTEE C-9 ON CONCRETE AND CONCRETE AGGREGATES—*Chairman*, F. E. Richart, University of Illinois, Urbana, Ill.; *Vice-Chairman*, Kenneth B. Woods, Purdue University, W. Lafayette, Ind.

COMMITTEE C-11 ON GYPSUM—*Vice-Chairman*, H. F. Gardner, Certain-ty Products Corp., Chicago 7, Ill.

COMMITTEE C-12 ON MORTARS FOR UNIT MASONRY—*Chairman*, Theodore I. Coe, American Institute of Architects, Department of Technical Services, Washington 6, D. C.; *First Vice-Chairman*, J. W. Whittemore, Virginia Polytechnic Inst., Blacksburg, Va.

COMMITTEE C-14 ON GLASS AND GLASS PRODUCTS—*Chairman*, Louis Navias, General Electric Co., Schenectady 5, N. Y.; *Secretary*, S. R. Scholes, N. Y. State College of Ceramics, Alfred Univ., Alfred, N. Y.

COMMITTEE C-16 ON THERMAL INSULATING MATERIALS—*Honorary Chairman*, J. H. Walker, The Detroit Edison Co., Detroit 26, Mich.

COMMITTEE D-1 ON PAINT, VARNISH, LACQUER, AND RELATED PRODUCTS—*Chairman*, W. T. Pearce, Consultant on Organic Coatings, Narberth, Pa.; *Secretary*, C. H. Rose, National Lead Co., Brooklyn 1, N. Y.

COMMITTEE D-4 ON ROAD AND PAVING MATERIALS—*Chairman*, Shreve Clark, Virginia Department of Highways, Richmond 19, Va.; *Vice-Chairman*, W. J. Emmons, University of Michigan, Ann Arbor, Mich.

COMMITTEE D-5 ON COAL AND COKE—*Vice-Chairman*, O. O. Malleis, Bituminous Coal Producers Advisory Board for District No. 8, Cincinnati 2, Ohio.

COMMITTEE D-8 ON BITUMINOUS WATERPROOFING AND ROOFING MATERIALS—*Chairman*, J. S. Miller, Consultant on Asphalt Technology, Rahway, N. J.

COMMITTEE D-11 ON RUBBER AND RUBBER-LIKE MATERIALS—*Chairman*, Simon Collier, Johns-Manville Corp., 22 E. Fortieth Street, New York 16, N. Y.; *Vice-Chairman*, H. E. Outcault, St. Joseph Lead Co., New York 17, N. Y.

COMMITTEE D-13 ON TEXTILE MATERIALS—*First Vice-Chairman*, A. G. Ashcroft, Alexander Smith and Sons Carpet Co., Yonkers 1, N. Y.; *Second Vice-Chairman*, A. G. Scroggie, E. I. du Pont de Nemours and Co., Richmond 12, Va.

COMMITTEE D-18 ON SOILS FOR ENGINEERING PURPOSES—*Secretary*, L. R. Douglass, U. S. Bureau of Reclamation, Washington 25, D. C.

COMMITTEE E-2 ON SPECTROGRAPHIC ANALYSIS—*Secretary*, Mary E. Wurga, University of Pittsburgh, Pittsburgh 13, Pa.

COMMITTEE E-3 ON CHEMICAL ANALYSIS OF METALS—*Vice-Chairman*, H. A. Bright, National Bureau of Standards, Washington 25, D. C.; *Secretary*, J. W. Stillman, E. I. du Pont de Nemours and Co., Wilmington 98, Del.

COMMITTEE E-4 ON METALLOGRAPHY—*Vice-Chairman*, R. E. Penrod, Bethlehem Steel Co., Inc., Johnstown, Pa.

COMMITTEE E-7 ON RADIOGRAPHIC TESTING—*Vice-Chairman*, D. M. McCutcheon, Ford Motor Co., Dearborn, Mich.; *Secretary*, A. Morrison, National Research Council of Canada, Ottawa, Ont., Canada.

COMMITTEE E-9 ON RESEARCH—*Chairman*, R. J. Moore, Bakelite Corp., Bloomfield, N. J.



Officers of Committee C-16 on Thermal Insulating Materials. From left to right, E. T. Cope, Chairman; R. H. Jebens, Vice-Chairman; and Ray Thomas, Secretary.

Publication Notes

THE THREE MOST recent A.S.T.M. publications issued in late October or November are the Compilation of Standards on Petroleum Products and Lubricants, Symposium on Plastics, and the Year Book. Each of these publications has certain distinctive characteristics worthy of note.

Year Book

One of the interesting features of any A.S.T.M. Year Book is the considerable portion of the book devoted to lists of personnel of the standing committees, and in the current Year Book which has just gone in the mails 200 pages are devoted to data on the technical committees. No other organization has the committee structure which characterizes A.S.T.M. activities and this information is of very widespread service to committee officers and members. This year additional information is included in the portion devoted to District Committees with past-officers being noted.

That portion of the book devoted to alphabetical listing of the members with complete addresses is, of course, more extensive than in previous books because of the new high in membership, close to 5200.

The section of the book providing General Information about the Society has been re-edited and three tables have been included summarizing information on membership, publications received, etc.; another gives the location, dates, and outstanding technical topics of the Annual Meetings; and this same information is also included for the Spring Meeting. This information will be of distinct interest to many of the members and will be helpful in a variety of ways. Reprints of this material are being struck off plus personnel of District Committees, a list of winners of the Dudley Medal, and Marburg Lecturers, and a copy will be furnished to members on request. Frequent requests are received for information about the Society, and this material will be helpful in this connection.

A copy of the Year Book has been mailed to all of those members who requested it.

Symposium on Plastics

After much detailed work on the part of the authors of the technical papers and the Staff, the Symposium on Plastics has been issued in the form of a 200-page book. This publication has been awaited with much interest by members and others concerned with the subject. It is safe to say that the book is well worth waiting for because it includes in compact form a great amount of authoritative data on the properties and tests of various families of plastics. More than one authority has commented on the outstanding nature of the papers included and many have already been reprinted in the technical press.

Numerous features might be mentioned including the bibliographies appended to several of the papers, notably the one by Carswell and Nason on Mechanical Properties. Some of the papers are the culmination of years of work in compiling data. One of the unique aspects is that portion devoted to a summary of the properties, uses, and

salient features of families of plastics with a suitable introduction and the details of various plastic families with their respective properties and uses detailed.

A prospectus describing this book and listing the special price to members, of \$1.25 in paper, and \$1.75 in cloth, was mailed early in the Summer.

Standards on Petroleum Products and Lubricants

This book, sponsored annually by Committee D-2 on Petroleum Products and Lubricants and the first special compilation to be issued by the Society, is probably the most widely used. It has appeared yearly since 1927, and several thousand copies of each issue are regularly distributed. Comparing the first edition with the latest 1944 book, one finds much the same arrangement, that is, first the annual report of the committee detailing numerous changes, then special reports of subcommittees and appended material, followed by the standards in their latest approved form. However, the similarity soon ends for the current book comprises some 524 pages as compared with 248 in the first edition and with the two-column format now in effect the increased volume of material is even greater. There were 41 standards in the 1927 edition and 80 in the current book.

Of particular interest in the latest book are conversion tables for petroleum oils of metric tons in vacuo to long and short tons in air, a discussion on oil measurement and certain proposed tests. The book is complete with all the current specifications and tests in this field included.

This book was listed in the Members Order Blank recently distributed. Members' price is \$1.80, compared with the list price of \$2.75.

Distribution Dates for 1944 Standards Book

ALTHOUGH SEVERAL 1944 compilations of standards have been published, as announced in the BULLETIN, covering coal and coke, mineral aggregates, petroleum products, and textile materials, these books have not interfered with the printing of the 1944 Book of A.S.T.M. Standards. Several forms in the big book are released each day and gradually the amount of material remaining to be published in the three parts of the 1944 Book is becoming less "mountainous."

While printing alone offers a variety of problems, issuance of the extensive books is further complicated by folding, binding and mailing work—the latter involving the fabrication of shipping cases, etc. All of these things add up to the following estimates as to the dates respective parts of the Book of Standards will be in the mails. Depending on the location of the members and their position in the alphabetical sequence, they will need to add a minimum of from one to three weeks to these dates.

Part II, Nonmetallic Materials—Constructional.....	January 5, 1945
Part I, Metals.....	January 19, 1945
Part III, Nonmetallic Materials—General.....	February 9, 1945

Following distribution of the books to the members, the mailing of the volumes to purchasers will get under way.

Actions on Standards

(Continued from page 6)

of the 1944 Book of A.S.T.M. Standards, Part I. These methods are being extensively expanded this year (actions taken at the Annual Meeting) by the incorporation of three tentative standards published last year for the first time—the designations formerly used were A 257, A 258, and A 259.

White Metal Bearing Alloys; Soft Solder Metal:

Changes which have become effective in the Emergency Provisions EA - B 23b, White Bearing Alloys, as detailed in the back portion of this BULLETIN consist of the modification of Table I on chemical requirements and corresponding data in the table on physical properties. The emergency alternate as thus written lists the currently used low tin Babbitts which are permitted for general application under the terms of the latest edition of Tin Conservation Order M-43. The requirements and properties of three alloys from the standard B 23 are listed together with four of the present six alternate grades listed in EA - B 23a and an additional low tin grade which conforms to A.S.T.M. Specifications B 67 - 44.

Changes in the emergency alternate provisions effective in the solder metal specifications B 32, published elsewhere in this BULLETIN, are a complete revision of the present Table I on chemical requirements and Table II on the properties of the various alloys listed. The alloys listed have been given an entirely new series of numbers so that there will be no conflict or confusion with the numbers assigned in the former emergency alternate. The alloys are again those currently in general use and permitted for certain specific applications by the terms of the Conservation Order M-43. Where there are corresponding alloys, those tabulated conform quite generally with the alloys expected to be issued in a proposed revision of the Federal Specification for Solder QQ-S-571a.

Aluminum Alloys for Die Castings:

Committee B-7 on Light Metals and Alloys, Cast and Wrought, has prepared revisions in three of its tentative specifications as noted in the list—the requirements for alloys in ingot form for sand castings, and for permanent mold castings, providing a number of changes in chemical composition. These new requirements will bring the specifications in line with current practice and with changes made in some of the product specifications, for example, sand castings (B 26), and the mold castings (B 108). Similar reasons justify the changes in the materials in ingot form for die castings (B 125).

Salt Spray Testing of Organic Coatings:

On the recommendation of Committee D-1, the emergency salt spray tests on organic protective coatings (E - 3) have been withdrawn, this action being taken because of the issuance of extensively revised Tentative Method of Salt Spray Fog Corrosion Test (B 117 - 44 T). These revised methods have resulted from several conferences held earlier this year in efforts to coordinate various practices and thoughts. The new methods describe suitable equipment, but do not prescribe the type of specimen, or expos-

ure period, nor interpretation of results. Comments on using the test in research work are also included. Copies of this revised method are being included in the Book of Standards and because of this will not be available separately for some weeks.

Tests for Turpentine:

At the same time that the Society's Committee D-1 on Paint, Varnish, Lacquer, and Related Products recommended changes in the Methods of Sampling and Testing Turpentine (D 233 - 36), it suggested their issuance in the form of a tentative standard with the withdrawal of the formal standard and this has been done. Changes involve the section on sampling where it is changed by a cross reference to the methods of sampling D 268, the establishment of a "standard" and a "water-white" grade which are well recognized and are defined by reference to colorimeter standards. The distillation section has been condensed, and thermometer requirements modified with an alternate thermometer permissible. A more condensed table showing the temperature correction for barometric pressure has been added and details on the polymerization test are included. These changes, based on experience of a number of analysts, should lead to more consistent results.

Petroleum Products:

Referring to the list in the October BULLETIN of tentative methods of tests for chlorine, phosphorus, and certain metals in lubricating oils (D 808 to D 811, inclusive), these new tentative methods formerly had been issued as emergency standards. With the transfer of these methods from emergency to regular status, revisions were also incorporated in the methods for determining phosphorus, and other metals such as barium, tin, zinc, etc.

Insulated Wire and Cable:

In order that the flame test to be used in the Methods of Testing Rubber Insulated Wire and Cable (D 470 - 41) and the Specifications for Heat-Resisting Compound (D 754) and Performance Synthetic Rubber Compound (D 755) would be in line with the emergency Underwriters' requirements, the provisions as detailed elsewhere in this BULLETIN have been approved. At the same time the committee acted to modify the emergency provisions for insulated wire and cable: ozone-resistant type insulation EA - D 574, reducing the present requirement for elongation at rupture after 168 hours air oven test from 200 to 150 per cent. The higher figure could not be met consistently, and the committee feels that the lower figure will not result in any material lowering of quality.

Portland Cement:

WPB Order L-179 covering the manufacture of portland cement has been withdrawn. The Society consequently has cancelled the Emergency Alternate Specifications EA - C 150, see page 52 for details.



Men of the Headquarters Staff.—First Row—P. J. Smith, J. K. Rittenhouse, C. L. Warwick, R. E. Hess; Second Row—J. H. Wolfe, M. D. Huber, G. A. Wilson, C. S. Cole, R. J. Painter

Emergency Specifications for Cement Discontinued

Announcement has recently been made by the War Production Board that General Limitation Order L-179 covering the manufacture of cement has been revoked. This limitation order limited the manufacture of cement to three specified types, and the order was designed to increase production of these three most commonly used types by prohibiting the manufacture of modifications of these. Emergency Specifications bearing the designation EA-C 150 had been issued by the Society in order to provide A.S.T.M. specifications that would be in compliance with the limitation order. Since the limitation order has now been rescinded on recommendation of the Society's Committee C-1 on Cement the Emergency Specifications EA-C 150 have been withdrawn.

Ladies of the Headquarters Staff.—First Row—Laura F. Lautenbach, Florence Artis, Dorothy Mays, Marjorie Robinson, Jane B. Wheeler, Marie A. Ounan, Mary E. Dickson, Dorothy E. Hand, Hazel Reilley, Elizabeth F. Decker; Second Row—Ruth Sefton, Elsie M. Stover, Mildred Odiorne, Evelyn Huber, Emily Krauss, Margaret L. Beach, Helen K. Cressman, Bette Bailey, Dorothy P. Douty, Marion R. Bauer



EDITOR'S NOTE.—The photographs of the Headquarters Staff appearing on this page and of the two groups on page 53 were taken at the meeting on October 12 at which the Society received the Ordnance Distinguished Service Award.

Materials Supply List

ISSUE NUMBER 14 of the Materials Substitutions and Supply List, these lists having been sponsored by the WPB Conservation Division, is of interest for several reasons. It is the final issue since the general easing of many important materials makes its publication no longer necessary. Also, the list notes materials which are likely to remain scarce after "V-E Day." Since Issue Number 13, earlier in the summer, there have been many shifts in material from the essential group I (insufficient to meet war plus essential industry needs) to Groups II and III which are sufficient to supply war plus essential industrial demands.

This last list points out that supply of fabricated and semifabricated metal products continues to be tighter than the metals themselves, due to shortages in either manpower or in manufacturing facilities, or both. Among such ferrous items are malleable iron castings; small and medium size steel castings; automotive type gray iron castings; wire rope and rope wire. For non-ferrous metals, such shortages are in copper and copper-base alloy tubing over 4 in.; all insulated copper wire, cable and cords (other than weatherproof wire and cable). Similar shortages are found in tungsten and molybdenum rod, wire, and sheet.

Cotton broad-woven fabrics continue to be in short supply, particularly cotton duck, heavy twill and certain types of cotton rope, caused by insufficient facilities and manpower.

Lumber supply remains critical, especially for crating, though the poorer grades of some hardwoods have eased.

While the list of materials—chemicals, plastics, grades of lumber, textiles, fuels and miscellaneous materials in Group I is still rather startling, they are considerably smaller than carried in earlier lists. Materials that are expected to continue scarce after "V-E Day," regardless of military cutbacks, include: cadmium; chromium metal; sodium; tin; alkyd resins; polyethylene; vinyl resins; agave (including sisal); pig and hog bristles, 3 1/4 in. and over; cattle hides; cotton broad-woven goods; kapok; manila; distillate fuel oil; anthracite; bituminous coal (by-product quality); container board; corundum; paper and products (including waste paper); pyrethrum; rotenone; crude and latex rubber.

Copies of this final list can be obtained from the nearest WPB District Office or the Inquiry Office, WPB, 1501 Social Security Bldg., Washington 25, D. C.



BASED ON considerable cooperative work, Committee C-1 on Cement through its Sponsoring Committee on Portland Cement has developed the Tentative Method of Test for Determining Air Content of Portland Cement Mortar (C 185-44 T). Results of the cooperative tests were published in the current report of the committee. This method makes use of a Burmister Mortar Flow Trough and it is thought that a number of technologists concerned with this test would be interested in having a more detailed drawing of the equipment than is shown in the standard, although the latter does give necessary dimensions and information. The accompanying views and detail are furnished in a drawing from the Central Concrete Laboratory, Corps of Engineers, U. S. Army. Charles E. Wuerpel, chairman of the Sponsoring Committee is Engineer in Charge.

AT A JOINT meeting sponsored by the New York Chapters of the American Society for Metals and the American Welding Society and the Metropolitan Chapter of the American Foundrymen's Association, N. L. Mochel, Manager, Metallurgical Engineering, Westinghouse Electric and Manufacturing Co., is to speak on the intriguing subject "Shall it be Cast, Wrought, or Welded?" The meeting is to be held on the evening of January 8 at 7:45 o'clock at 2 Park Ave., at the Building Trades Club. The auditorium is on the twenty-sixth floor. T. D. Parker, local A.F.A. chairman is presiding at the meeting. This subject should be of interest to all concerned with metallurgy and fabrication of metals. It is a topic with which Mr. Mochel is constantly confronted and he speaks with authority on it.

ALL THOSE concerned with permanent magnets will undoubtedly find of interest a recent publication described in the November issue of the National Bureau of Standards Technical News Bulletin. "The range of usefulness of permanent magnets has been very greatly extended in recent years by the development of new and superior materials for their construction. However, the mere substitution of a new material without a corresponding modification in design generally leads to disappointing

results. For some applications, it may even be better to use the older, less expensive materials. In view of the many requests that the Bureau receives for information on this subject, a publication, Circular C448, has been prepared by Raymond L. Sanford, giving a summary of the data available in the technical literature, and a brief discussion of the design and testing of permanent magnets. Copies are obtainable from the Superintendent of Documents, Government Printing Office, Washington 25, D. C. The price is 10 cents."

(Arranged in Chronological Order)

SOCIETY OF AUTOMOTIVE ENGINEERS—Annual Meeting and Engineering Display, January 8-12, Book-Cadillac Hotel, Detroit, Mich.
AMERICAN SOCIETY OF CIVIL ENGINEERS—Annual Meeting, January 17-19, Hotel Commodore, New York, N. Y.
AMERICAN SOCIETY OF HEATING AND VENTILATING ENGINEERS—Fifty-first Annual Meeting, January 22-24, Hotel Statler, Boston, Mass.
NEW YORK WAR PRODUCTION AND RECONVERSION CONFERENCE—January 30, Hotel Commodore, New York, N. Y.
AMERICAN CONCRETE INSTITUTE—Forty-first Annual Convention, February 13-16, Hotel New Yorker, New York, N. Y.
AMERICAN INSTITUTE OF MINING AND METALLURGICAL ENGINEERS—Annual Meeting, February 18-22, Hotel Pennsylvania, New York, N. Y.



A. O. Bergholm, Office of Chief of Ordnance; John S. Worth, Bethlehem Steel Co.; N. L. Mochel, Westinghouse Electric and Manufacturing Co.; A. P. Spooner, Bethlehem Steel Co.

ASTM Bulletins—1944

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EA - A 1a

Issued, April 6, 1942

And as modified by A.R.E.A. Proposed Recommended Practice for the Control Cooling of Railroad Rails, amended Oct. 20, 1943

(The latest provisions EA - A 1a incorporating the modified control cooling practice were issued August 28, 1944.)

The revision in this Emergency Alternate Provision, occasioned by a modification in the WPB order, involves only Appendix II which is the A.R.E.A. Recommended Practice for Control Cooling. Paragraph 6 is changed to read as follows:

6. The container shall be so protected or insulated that the control temperature shall not drop below 300 F. in 7 hr. for rails 100 lb. per yd. in weight or heavier, from the time that the bottom tier is placed in the container and in 5 hr. for rails of less than 100 lb. per yd. in weight.

The latest A.R.E.A. Practice is also published in their Bulletin No. 444, February, 1944, p. 399. On October 20, 1943, this paragraph formerly dated 1941, as shown in A.R.E.A. Bulletin, No. 430, Feb., 1942, p. 617, was revised to read as shown. The 1941 version had a minimum control temperature of 7 hr. for all rails regardless of weight.

EA - A 268

Issued, October, 1944

The following Emergency Alternate Provisions, when specified, may be used as alternates in A.S.T.M. Tentative Specifications for Seamless and Welded Ferritic Stainless Steel Tubing for General Service (A 268 - 44 T) and affect only the requirements referred to:

Table I.—Change the requirements as to chemical composition for grades 410, 430, 443, and 446 to read as follows:

TABLE I.—CHEMICAL REQUIREMENTS.

Identification Symbol.....	410	430	443
Carbon, max., per cent.....	0.15	0.12	0.20
Manganese, max., per cent....	1.00	1.00	1.00
Phosphorus, max., per cent....	0.04	0.04	0.04
Sulfur, max., per cent.....	0.04	0.04	0.04
Silicon, max., per cent.....	1.00	1.00	1.00
Nickel, per cent.....	0.50 max.	0.50 max.	0.50 max.
Chromium, per cent.....	10.0 to 14.0	14.0 to 18.0	18.0 to 23.0
Molybdenum, per cent.....	...	...	...
Aluminum, per cent.....	...	...	...
Copper, per cent.....	...	...	0.90 to 1.25
Nitrogen, per cent.....	...	...	...

Identification Symbol.....	446	329
Carbon, max., per cent.....	0.20	0.20
Manganese, max., per cent....	1.00	1.00
Phosphorus, max., per cent....	0.04	0.04
Sulfur, max., per cent.....	0.04	0.04
Silicon, max., per cent.....	1.00	1.00
Nickel, per cent.....	0.50 max.	2.5 to 5.0
Chromium, per cent.....	23.0 to 30.0	23.0 to 28.0
Molybdenum, per cent.....	...	1.0 to 2.0
Aluminum, per cent.....	...	...
Copper, per cent.....	...	...
Nitrogen, per cent.....	0.10 to 0.25	...

EA - A 269

Issued, October, 1944

The following Emergency Alternate Provisions, when specified, may be used as alternates in A.S.T.M. Tentative Specifications for Seamless and Welded Austenitic Stainless Steel Tubing for General Service (A 269 - 44 T) and affect only the requirements referred to:

Table I.—Change the requirements as to chemical composition to read as follows:

Emergency Specifications and E. A.'s

A COMPLETE list of the emergency specifications and emergency alternate provisions in effect as of October 16 appeared in the October BULLETIN. Some additions to the list have been made as will be noted from the article on standards activities in another portion of this BULLETIN. It is hoped to issue in the next few weeks a pamphlet giving a complete list of A.S.T.M. standards and tentative standards with latest serial designations. A copy will be mailed on request to any member.

TABLE I.—CHEMICAL REQUIREMENTS.

Identification Symbol.....	304	321	347
Grade.....	Chromium-Nickel	Chromium-Nickel-Titanium	Chromium-Nickel-Columbium
Carbon, max., per cent.....	0.08	0.10	0.10
Manganese, max., per cent....	2.00	2.00	2.00
Phosphorus, max., per cent....	0.04	0.04	0.04
Sulfur, max., per cent.....	0.04	0.04	0.04
Silicon, max., per cent.....	1.00	1.00	1.00
Nickel, per cent.....	8.0 to 10.0 ^a	8.0 to 12.0 ^a	8.0 to 12.0 ^a
Chromium, per cent.....	18.0 to 20.0	17.0 to 19.0	17.0 to 19.0
Molybdenum, per cent.....	...	...	...
Titanium, per cent.....	...	...	...
Columbium, per cent.....	...	...	...

Identification Symbol.....	316	317
Grade.....	Chromium-Nickel-Molybdenum	Chromium-Nickel-Molybdenum
Carbon, max., per cent.....	0.10	0.10
Manganese, max., per cent....	2.00	2.00
Phosphorus, max., per cent....	0.04	0.04
Sulfur, max., per cent.....	0.04	0.04
Silicon, max., per cent.....	1.00	1.00
Nickel, per cent.....	10.0 to 14.0	10.0 to 14.0
Chromium, per cent.....	16.0 to 18.0	17.5 to 20.0
Molybdenum, per cent.....	1.75 to 2.50	3.0 to 4.0
Titanium, per cent.....	...	...
Columbium, per cent.....	...	...

^a If deemed necessary by the tubing manufacturer to obtain good piercing properties, the maximum nickel content of grade 304 may be increased to 11.0 per cent and of grades 321 and 347 to 13.0 per cent.

^b Grade 321 shall have a titanium content of not less than four times the carbon content and not more than 0.60 per cent.

^c Grade 347 shall have a columbium content of not less than eight times the carbon content and not more than 1.0 per cent.

EA - A 270

Issued, October, 1944

The following Emergency Alternate Provisions, when specified, may be used as alternates in A.S.T.M. Tentative Specifications for Seamless and Welded Austenitic Stainless Steel Tubing for the Dairy and Food Industry (A 270 - 44 T) and affect only the requirements referred to:

Table I.—Change the requirements as to chemical composition for grade 304 to read as follows:

TABLE I.—CHEMICAL REQUIREMENTS.

Identification Symbol.....	304
Grade.....	Chromium Nickel
Carbon, max., per cent.....	0.08
Manganese, max., per cent....	2.00
Phosphorus, max., per cent....	0.04
Sulfur, max., per cent.....	0.04
Silicon, max., per cent.....	1.00
Nickel, per cent.....	8.0 to 10.0 ^a
Chromium, per cent.....	18.0 to 20.0

^a If deemed necessary by the tubing manufacturer to obtain good piercing properties, the maximum nickel content of grade 304 may be increased to 11.0 per cent.

EA - A 271

Issued, October 25, 1944

The following emergency Alternate Provisions, when specified, may be used as alternates in A.S.T.M. Tentative Specifications for Seamless Austenitic Chromium-Nickel Steel Still Tubes for Refinery Service (A 271-44 T) and affect only the requirements referred to:

Table I.—Change the requirements as to chemical composition to read as follows:

TABLE I.—CHEMICAL REQUIREMENTS.

Identification Symbol.....	304	321	347
Carbon, max., per cent.....	0.08	0.10	0.10
Manganese, max., per cent.....	2.00	2.00	2.00
Phosphorus, max., per cent.....	0.04	0.04	0.04
Sulfur, max., per cent.....	0.04	0.04	0.04
Silicon, max., per cent.....	1.00	1.00	1.00
Chromium, per cent.....	18.0 to 20.0	17.0 to 19.0	17.0 to 19.0
Nickel, per cent.....	8.0 to 10.0 ^a	8.0 to 12.0 ^a	8.0 to 12.0 ^a
Titanium, per cent.....	...	...	...
Columbium, per cent.....	...	...	...

^a If deemed necessary by the tubing manufacturer to obtain good piercing properties, the maximum nickel content of grade 304 may be increased to 11.0 per cent and of grades 321 and 347 to 13.0 per cent.

^b Grade 321 shall have a titanium content of not less than four times the carbon content and not more than 0.60 per cent.

^c Grade 347 shall have a columbium content of not less than eight times the carbon content and not more than 1.0 per cent.

EA - B 236

Issued, October 24, 1944

(Superseding Issues of April 6, 1942, and January 5, 1943)

The following Emergency Alternate Provisions, when specified, may be used as alternates in A.S.T.M. Standard Specifications for White Metal Bearing Alloys (Known Commercially as "Babbitt Metal") (B 23-26) and affect only the requirements referred to:

Section 4 and Table I.—Conservation Order M-43 of the War Production Board places certain restrictions on the use of tin in babbitts. Attention is directed to the latest issue of this Conservation order for permissible uses of babbitts containing more than 12 per cent tin.

The following alloys^a are commercially available and currently may be employed without restriction.

TABLE I.—CHEMICAL REQUIREMENTS.^a

Alloy Grade	Tin, per cent	Antimony, per cent	Lead, per cent	Copper, per cent	Arsenic, per cent
No. 7.....	10.0	15.0	75.0	0.50 max.	0.20 max.
No. 8.....	5.0	15.0	80.0	0.50 max.	0.20 max.
No. 10.....	2.0	15.0	83.0	0.50 max.	0.20 max.
No. 14.....	0.75	12.75	remainder	...	1.5 to 3.0
No. 15.....	0.90 to 1.25	14.5 to 15.5	remainder	0.60 max.	0.8 to 1.1
No. 16.....	10.0	12.5	remainder	0.40 to 0.60	...
No. 18.....	1.0	17.0	remainder	0.40 to 0.60	0.8 to 1.4
No. 19 ^b ...	4.0 to 6.0	8.0	remainder	0.5 max.	0.2 max.

^a Where tolerances or limits are not prescribed in this table, the permissible variations specified in Section 5 of Standard B 23-26 apply.

^b Alloy No. 19 conforms to the requirements for the chemical composition of backing specified in Standard Specifications for Car and Tender Journal Bearings, lined (A.S.T.M. Designation: B 67).

Appendix.—Add the following data as information to the table of physical properties of white metal bearing alloys which appears in the Appendix of Standard B 23-26:

PHYSICAL PROPERTIES OF ALTERNATE ALLOYS.

Alloy Grade	Brinell Hardness		Melting Ranges				Pouring Temperature	
			Solidus		Liquidus			
	At 20 C.	At 100 C.	Deg. Fahr.	Deg. Cent.	Deg. Fahr.	Deg. Cent.	Deg. Fahr.	Deg. Cent.
No. 7.	22.5	10.5	464	240	514	268	640	338
No. 8.	20.0	9.5	459	237	522	272	645	341
No. 10.	17.5	9.0	468	242	507	264	630	332
No. 14.	22.0	15.0	469	243	563	295	689	365
No. 15.	21.0	13.0	...	...	...	...	...	...
No. 16.	27.5	13.6	471	244	495	257	621	327
No. 18.	29.0	16.0	...	...	...	...	875	468
No. 19. ....	...	...	...	...	...	...	...	...

EA - B 326

Issued October 24, 1944

(Superseding Issues of April 6, 1942, and January 5, 1943)

The following Emergency Alternate Provisions, when specified, may be used as alternates in A.S.T.M. Tentative Specifications for Soft Solder Metal (B 32-40 T) and affect only the requirements referred to:

Section 1 (a).—These specifications cover ten alloys of tin-lead and tin-lead-antimony solders and one lead-silver solder alloy, as shown in Table I.

(b) Recommended practice is given in the notes beneath Table II. Tables I and II include both chemical and physical properties. This information is given as a guide to the purchaser in selecting the alloy best suited for meeting the required conditions.

Section 3.—Conservation Order M-43 of the War Production Board places certain restrictions on the use of tin in solder. Attention is directed to the solders listed in Tables I and II which may be used for certain specific applications by the terms of Conservation Order M-43. (Refer to the latest issue of this order for details.)

Section 4 (a).—Tin content shall be as shown in Table I in the column headed "Tin."

(b) Antimony content shall be as shown in Table I in the column headed "Antimony."

(c) Silver content shall be as shown in Table I in the column headed "Silver."

(d) Lead shall be the remainder. The column designated "Lead Nominal" is only the approximate lead content.

(e) Impurities shall be within the limits for other elements specified in Table I under the main section of this table.

TABLE I.—CHEMICAL REQUIREMENTS.^a

Alloy Grade	Tin, per cent	Lead (Nominal), per cent	Antimony, per cent	Silver, per cent
No. 21.....	49.5 to 50.5	50	0.5 max.	...
No. 22.....	39.5 to 40.5	60	0.5 max.	...
No. 23.....	39.5 to 40.5	57.75	2.0 to 2.5	...
No. 24.....	34.5 to 35.5	65	0.5 max.	...
No. 25.....	34.5 to 35.5	63	1.75 to 2.0	...
No. 26.....	29.5 to 30.5	68.3	1.5 to 1.75	...
No. 27.....	19.5 to 20.5	78.5	1.25 to 1.50	...
No. 28.....	14.5 to 15.5	84.5	0.25 to 0.50	...
No. 29.....	4.5 to 5.5	95	0.5 max.	...
No. 30.....	2.5 to 3.5	97	0.5 max.	...
No. 31.....	0.25 max.	97.5	0.4 max.	2.3 to 2.7

^a Other Elements: Bismuth 0.25 max.; Copper 0.08 max. (except No. 31 Copper 0.3 max.); Iron 0.02 max.; Zinc 0.005 max.; Aluminum 0.0005 max.; and total other impurities 0.008 max. per cent.

TABLE II.—PROPERTIES OF SOFT SOLDER METAL.

Alloy Grade	Specific Gravity	Melting Range					
		Solidus		Liquidus		Pasty Range	
		Deg. Fahr.	Deg. Cent.	Deg. Fahr.	Deg. Cent.	Deg. Fahr.	Deg. Cent.
No. 21.....	8.85	361	183	421	216	60	33
No. 22.....	9.30	361	183	453	234	92	51
No. 23.....	9.14	363	184	444	229	81	45
No. 24.....	9.47	361	183	477	247	116	64
No. 25.....	9.42	363	184	459	237	96	53
No. 26.....	10.12	362	183	472	243	109	59
No. 27.....	10.50	361	183	543	254	182	71
No. 28.....	11.10	576	302	592	311	16	9
No. 29.....	...	594	312	603	317	9	5
No. 30.....	...	579	304	579	304	0	0

INFORMATION ON USES AND APPLICATIONS

No. 21.—For soldering galvanized iron and other metals, sweating joints in copper tubing, coating metals.

No. 22.—Same uses as (50-50), solder but where higher soldering temperatures can be permitted.

No. 23.—Same uses as (50-50) tin-lead but not recommended for use on galvanized iron.

No. 24.—For use on galvanized iron and other metals where antimony is not desirable and higher soldering temperatures can be tolerated.

No. 25.—For wiping and all uses except on galvanized iron.

No. 26.—For uses where torch soldering or machine soldering is used.

No. 27.—For machine soldering and coating of metals, tipping, and like uses.

No. 28.—For dip soldering of radiators, body solder, coating of metals, machine soldering, and like uses.

No. 29.—For machine soldering and coating of metals.

No. 30.—For body solder, coating of metals, machine soldering.

No. 31.—For use on copper, brass, and similar metals with torch heating.

EA - D 470

Issued, November 13, 1944

The following Emergency Alternate Provisions, when specified, may be used as alternates in A.S.T.M. Standard Methods of Testing Rubber Insulated Wire and Cable (D 470 - 41) and affect only the requirement referred to:

Sections 33 and 34.—Substitute the following Emergency Horizontal Flame Test for the flame test described in Sections 33 and 34:

Horizontal Flame Test

33. *Apparatus.*—The apparatus shall consist of the following:

(a) *Test Chamber.*—A test chamber of sheet metal 12 in. in width, 14 in. in depth, and 24 in. in height which is open at the top and front and provided with means for supporting the test specimen in a horizontal position.

(b) *Tirrell Burner.*—A Tirrell burner having a bore of $\frac{3}{8}$ in. and a length of 4 in. above the primary air inlets.

(c) *Watch.*—A watch or clock having a hand that makes one complete revolution per minute.

(d) *Gas.*—A supply of ordinary illuminating gas at normal pressure.

34. *Procedure.*—The test shall be made in a room generally free from drafts of air, but a ventilated hood may be used if air currents do not affect the flame. A test specimen 10 in. in length shall be centered in a horizontal position on supports 8 in. apart. The height of the flame, with the burner vertical, shall be adjusted to 5 in., with an inner blue cone $1\frac{1}{2}$ in. in height. The burner in a vertical position shall then be brought up to the specimen so that the inner blue cone just touches the underside of the specimen at a point midway between the supports. In this position the flame shall be directed against the specimen for a period of 30 sec. and then removed. During the test, as well as after the application of the flame, observation shall be made to determine whether or not the area of the specimen supporting the flame extends outside the area exposed to the flame. The behavior and duration of the flaming of the specimen after the application of the test flame shall also be noted.

EA - D 574b

Issued, November 13, 1944

(Superseding Issues of April 6, 1942, and November 27 1943)

The following Emergency Alternate Provisions, when specified, may be used as alternates in A.S.T.M. Tentative Specifications for Insulated Wire and Cable: Ozone-Resistant Type Insulation (D 574 - 40 T) and affect only the requirements referred to:

Section 1 (b).—Change to read as follows by the addition of the italicized words and figures:

(b) Except for the insulation, cable supplied under these specifications, unless otherwise specified by the purchaser, shall conform to the Standard Specifications for Insulated Wire and Cable: Class AO, 30 per cent Hevea Rubber Compound (A.S.T.M. Designation: D 27), *modified in accordance with the Emergency Alternate Provisions EA - D 27a, of the American Society for Testing Materials.*

Section 5, Table I.—Change the requirements for elongation at rupture after the 168 hr. air oven test and after the 48 hr. oxygen pressure test at 157 to 159 F. (69.4 to 70.6 C.) from "200 per cent" to read "150 per cent," minimum.

Section 7 (a).—In the legend under the formula for calculating insulation resistance, change the value for "K = constant of 5280" to read "K = constant of 1000."

EA - D 754

Issued, November 13, 1944

The following Emergency Alternate Provision, when specified, may be used as an alternate in A.S.T.M. Tentative Specifications for Insulated Wire and Cable: Heat-Resisting Synthetic Rubber Compound (D 754 - 43 T) and affects only the requirement referred to:

Section 5.—Add the following new Section 5 on Horizontal Flame Test, renumbering the subsequent sections accordingly:

5. *Horizontal Flame Test.*—The flame-retardant properties of fibrous coverings, other than tapes, on single conductor 600-v. wires, shall be such that the flaming section of a specimen subjected to the Emergency Horizontal Flame Test as prescribed in the Emergency Alternative Provisions EA - D 470 in the Standard Methods of Testing Rubber Insulated Wire and Cable shall not extend in either direction for a distance greater than 2 in. from the center point of the application of the test flame after the flame has been applied for a period of 30 sec.

EA - D 755

Issued, November 13, 1944

The following Emergency Alternate Provision, when specified, may be used as an alternate in A.S.T.M. Tentative Specifications for Insulated Wire and Cable: Performance Synthetic Rubber Compound (D 755 - 44 T) and affects only the requirement referred to:

Section 5.—Add the following new Section 5 on Horizontal Flame Test, renumbering the subsequent sections accordingly:

5. *Horizontal Flame Test.*—The flame-retardant properties of fibrous coverings, other than tapes, on single conductor 600-v. wires, shall be such that the flaming section of a specimen subjected to the Emergency Horizontal Flame Tests as prescribed in the Emergency Alternative Provisions EA - D 470 in the Standard Methods of Testing Rubber Insulated Wire and Cable shall not extend in either direction for a distance greater than 2 in. from the center point of the application of the test flame after the flame has been applied for a period of 30 sec.

EA - E 1

Issued, November 9, 1944

The following Emergency Alternate Provisions, when specified, may be used as an alternate in A.S.T.M. Standard Specifications for A.S.T.M. Thermometers (E 1 - 44) and affect only the requirements referred to:

A.S.T.M. Low Cloud and Pour Test Thermometers.—To provide thermometers for pour point tests at -65 F. (-54 C.) or lower as covered in the Emergency Alternate Provisions EA - D 97 in A.S.T.M. Standard Method of Test for Cloud and Pour Points (D 97 - 39), change the requirements for these thermometers as follows:

Temperature Range.—In the Centigrade thermometer E1(6C-39) change the lower temperature limit from "-60 C." to read "-80 C."

In the Fahrenheit thermometer E1(6F-39), change the lower temperature limit from "-70 F." to read "-112 F."

Marking on Case.—To agree with the changes in the new ranges of these thermometers, change the required marking on the case of the Centigrade thermometer E1(6C-39) from "-60 C." to read "-80 C." and, on the case of the Fahrenheit thermometer E1(6F-39), from "-70 F." to read "-112 F."

Low Gloss Standards

IN ORDER to meet definite needs of various industries concerned with the production of camouflage materials and related items for standards for determining gloss of very low order, the National Bureau of Standards has issued calibrated low-gloss standards. These are calibrated on the scales defined by Procedures A and C of the A.S.T.M. Tentative Method of Test for Specular Gloss of Paint Finishes, D 523.

Apparently measurements of low gloss even with what have seemed to be similar methods and with comparable equipment have given different results of a very significant order. The standards, which should be beneficial in remedying this situation, are issued in sets of 82 panels at a cost of \$20.

New Members to November 20, 1944

The following 50 members were elected from September 19 to November 20, 1944:

Chicago District

- BUEHLER, LTD., Adolph I. Buchler, General Partner, 165 W. Wacker Dr., Chicago 1, Ill.
WELCH, J. P., Chief Chemist, Chicago Lab., Illinois State Division of Highways, Bureau of Materials, 4051 N. Harlem Ave., Chicago 34, Ill.

Cleveland District

- EASTERN STATES BLAST FURNACE AND COKE OVEN ASSN., Max D. Wald, Assistant District Manager, Republic Steel Corp., Warren, Ohio.
NIX CO., THE KARL W. V., H. L. Swain, Technical Adviser, 202 Akron Savings and Loan Bldg., Akron 8, Ohio.
GENGER, ELIZABETH, Home Economist, Home Economics Inst., Westinghouse Electric and Manufacturing Co., 246 E. Fourth St., Mansfield, Ohio.
LITTLE, JOHN R., Chemist, The Hinde & Dauch Paper Co., 407 Decatur St., Sandusky, Ohio.

Detroit District

- BOYLAN, JAMES A., Technical Employee, Parker Rust-Proof Co., 2177 E. Milwaukee Ave., Detroit 11, Mich.
HERMAN, ALOYS FRANK, Partner, Herman & Simons, Architects, 131 Lafayette Blvd., W., Detroit 26, Mich.
QUINSEY, WILLIAM EDGAR, Assistant to Director, Department of Engineering Research, University of Michigan, 2034 E. Engineering Bldg., Ann Arbor, Mich.
SCHAEFER, ROBERT E., Director of Laboratories, Buick Motor Division, General Motors Corp., Flint, Mich. For mail: 2102 Begole St., Flint, Mich.

New York District

- ADHESIVES MANUFACTURERS ASSOCIATION OF AMERICA, Edward J. Steiger, Industry Consultant, 441 Lexington Ave., New York 17, N. Y.
PURATIZED, INC., C. N. Anderson, Director of Chemical Labs., 250 E. Forty-third St., New York 17, N. Y.
BONIFACE, A. O., Trade Association Executive, 366 Madison Ave., New York 17, N. Y.
CLIFFORD, A. C., Engineer, Personnel, Western Electric Co., Inc., 100 Central Ave., Kearny, N. J.
EASTY, ROBERT B., Manager, American Abrasive Metals Co., 460 Coit St., Irvington, N. J. For mail: 401 N. Fullerton Ave., Montclair, N. J.
IVANOV, Y. M., Professor, Doctor of Technical Sciences, Government Purchasing Commission of the U.S.S.R. in the U.S.A. and Central Institute of Industrial Building Research in Moscow, 210 Madison Ave., New York 16, N. Y.
KRUSTANGEL, FRANK, Lieutenant, Marine Engineer, United States Maritime Service, W. Forty-fourth St., New York, N. Y. For mail: 35-33 Sixty-fourth St., Woodside, L. I., N. Y.
ORR, DOUGLAS, Architect, 96 Grove St., New Haven, Conn.
RADIOAN, FRANK J., County Engineer, County of Hudson, Court House, Jersey City 6, N. J.
REYNOLDS, HERBERT B., Superintendent, Motive Power, New York City Transit System, 600 W. Fifty-ninth St., New York 19, N. Y.
SCHOFER, ERNEST A., Executive Secretary, Alloy Casting Inst., 39 Broadway, New York 6, N. Y.
SKRAMTAIEV, B. G., Professor, Doctor of Technical Sciences, Government Purchasing Commission of the U.S.S.R. in the U.S.A. and Central Institute of Industrial Building Research in Moscow, 210 Madison Ave., New York 16, N. Y.

Northern California District

- BURNHAM, JOHN R., Civil Engineer, County Surveyor's Office, Solano County, Fairfield, Calif. For mail: 1034 Virginia St., Vallejo, Calif.
MORGAN, ROLAND J., Manager, Mechanical Spring Div., L. A. Young Spring and Wire Corp., 900 High St., Oakland 1, Calif.

Philadelphia District

- BLAW-KNOX CO., SPECIAL ORDINANCE DIVISION, E. R. Broden, Division Manager, Box 1352, York, Pa.
BJORKSTEN, JOHAN, Chemical Director, Quaker Chemical Products, Corp., Conshohocken, Pa.
HALLETT, L. T., Head, Analytical Section, General Aniline and Film Corp., Easton, Pa.

JOHNSON, RAYMOND C., Vice-President, Anthracite Industries, Inc., Primos, Delaware County, Pa. For mail: Alden Park Manor, Germantown, Philadelphia 44, Pa.

SANDERS, FRANK H., Chemical Engineer, Catalytic Development Corp., Linwood, Pa. For mail: 104 E. Fortieth St., Wilmington 269, Del. [J]*

Pittsburgh District

- JONES, GEORGE TEDFORD, Chief Metallurgist, Carnegie-Illinois Steel Corp., Munhall, Pa. For mail: 11537 Clematis Blvd., Wilkinsburg, Pa.
OW, CHARLES HUNT, Specification Supervisor, Carnegie-Illinois Steel Corp., Munhall, Pa. For mail: R.D. 7, Bellevue, Pa.
ROWLAND, H. R., Manager, Hot Rolled Sales, A. M. Byers Co., Box 1076, Pittsburgh 30, Pa.

Southern California District

- GREEN, NATHANIEL B., Materials Inspection Engineer, North American Aviation, Inc., Inglewood, Calif. For mail: 6366 W. Eighty-fifth St., Los Angeles 43, Calif.
REYNOLDS, J. LYNN, Chief Metallurgist, Adel Precision Products Corp., 10777 Van Owen St., Burbank, Calif.

St. Louis District

- FOULKE, D. GARDNER, Chief Chemist, Houdaille-Hershey Corp., Decatur, Ill. For mail: 23 Central Dr., Decatur, Ill.

Western New York-Ontario District

- CURTIS-WRIGHT CORP., AIRPLANE DIVISION, W. S. Evans, Materials Engineer, Plant No. 2, Buffalo 5, N. Y.
BEISER, GEORGE, Methods Engineer, Bell Aircraft Corp., 2050 Elmwood Ave., Buffalo 7, N. Y.

U. S. and Possessions

OTHER THAN A.S.T.M. DISTRICTS

- SOLLBERGER ENGINEERING CO., A. G. Sollberger, Partner, Box 1186, Marshall, Tex.
UNITED REFRIGERATOR CO., INC., ENGINEERING DIVISION, E. W. Swedien, Director of Engineering, 551 E. Seventh St., St. Paul 1, Minn.
WEST POINT MANUFACTURING CO., Blake Lane, Head, Testing and Control Dept., Research Div., Shawmut, Ala.
BROWN, E. VERLIN, Chief Inspector, Curtiss-Wright Corp., Propeller Division, 1231 W. Morris St., Indianapolis 6, Ind.
DOSKER, C. D., Vice-President, Gamble Bros., Inc., 4600 Louisville Ave., Louisville 9, Ky.
HAWN, HERBERT W., Associate Professor of Mechanical Engineering, Michigan College of Mining and Technology, Houghton, Mich. For mail: 1006 E. Fifth St., Houghton, Mich.
KELLEHER, JOSEPH T., Research Engineer, Neveroil Bearing Co., 29 Foundry St., Wakefield, Mass.
TARR, ALLAN L., Supervisor, Metallurgical Lab., Basic Magnesium Incorporated, Henderson, Nev. For mail: 511 New Mexico St., Boulder City, Nev.
WINGTON, JOHN T., Director, Division of Technical Service, The Cotton-Textile Inst., Inc., New York, N. Y. For mail: Box 151, Clemson, S. C.
WOLTER, WILLIAM J., General Manager, Sturgeon Bay Shipbuilding and Dry Dock Co., Sturgeon Bay, Wis.

Other than U. S. Possessions

- TURBO RESEARCH LIMITED, K. F. Tupper, Chief Engineer, 30 Commercial St., Leaside, Ont., Canada.
BLASER, L. P., Resident Chemist, The British American Oil Co., Ltd., Moose Jaw, Sask., Canada.
LEY, FRANCIS DOUGLAS, Managing Director, Ley's Malleable Castings Co., Ltd., Derby, England.

* [J]—Denotes Junior Member.

Personals

... News items concerning the activities of our members will be welcomed for inclusion in this column.

A. H. EDGERLY, formerly Foreman, Instrument Repair, Bendix Radio Division, Bendix Aviation Corp., is now Instrument Repairman, A. S. Mancib Co., West Somerville, Mass.

HAROLD MOORE, C.B.E., who was appointed Director of the British Non-Ferrous Metals Research Association in 1932, retired on October 31 when, at the age of sixty-six, he had completed twelve years of service to the Association in this position.

W. C. POLLARD, formerly Chemist, Amertorp Corp., St. Louis, Mo., is now Spectrographer and Chemist, Dodge Chicago Plant Division, Chrysler Corp., Chicago, Ill.

E. B. RUBLOFF is now Chemical Supervisor, Ideal Chemical Products, Inc., Los Angeles, Calif. He was Research Engineer, Instrument Department, Basic Magnesium, Inc., Las Vegas, Nev.

MATTHEW JAY KESSLER, formerly connected with the Department of Aeronautics, New York University, New York, N. Y., as Engineer, is now Engineer with S. J. Kessler and Sons, New York, N. Y.

HERMAN BOWERS is now Metallurgist and Heat Treating Engineer in charge of Bogar-Schultz Laboratory, Chicago, Ill. He was connected with The Studebaker Corp., Aviation Division, as Metallurgist.

R. W. PLUMMER, formerly Technical Director, Industrias Quimicas Argentinas "Duperial," Buenos Aires, Argentina, is now Administrative Officer, Rubber Reserve Co., Washington, D. C.

LEONARD G. YODER, formerly Director of Field Engineering, The Beryllium Corporation of Pennsylvania, Reading, Pa., is now Consultant, Pittsburgh Tool Steel Wire Co., Monaca, Pa.

ROBERT H. CAREY, who was Assistant Professor of Engineering Mechanics, The Pennsylvania State College, is now Mechanical Engineer, Research and Development in Mechanical Testing, Bakelite Corp., Bound Brook, N. J.

PHILIP ROGER MARVIN is now connected with Milwaukee Gas Specialty Co., Milwaukee, Wis., as Director of Research and Development. He was Chief Metallurgical Engineer, Bendix Aviation Corp.

HOWARD H. LEH of the Keystone Portland Cement Co. has been elected Vice-President of the company.

A. GRIFFIN ASHCROFT is now Director of Research, Alexander Smith and Sons Carpet Co., Yonkers, N. Y. He was formerly Product Engineer for this company.

L. K. HERNDON, who was Assistant Professor, is now Associate Professor of Chemical Engineering, The Ohio State University, Columbus, Ohio.

A. KENNETH GRAHAM and C. A. CROWLEY have announced the formation of the firm of Graham, Crowley and Associates, Inc., as consulting electrochemists and engineers. This new organization is a consolidation of the professional practices of Technical Service Bureau, Inc., of Chicago, Ill., and A. Kenneth Graham and Associates of Jenkintown, Pa. The new organization has offices, libraries, and laboratories at 407 S. Dearborn St., Chicago, Ill., and at 473 York Road, Jenkintown, Pa.

H. H. LESTER, Principal Physicist, Watertown Arsenal, has been presented with the Exceptional Civilian Service Award of the War Department for extraordinary service within and beyond the call of duty.

ALBERT J. PHILLIPS has been promoted from Superintendent, to Manager of the Research Department of the American Smelting and Refining Co., Barber, N. J.

A. B. KINZEL, Chief Metallurgist of the Union Carbide and Carbon Research Laboratories, was recently appointed Vice-President of the Electro Metallurgical Co., New York, N. Y.

HENRY M. WILLIAMS, Vice-President in Charge of Engineering and Research, National Cash Register Co., Dayton, Ohio, has been awarded the Lamme Medal for "outstanding engineering achievement" for 1944 by Ohio State University.

J. L. SAVAGE, Chief Designing Engineer, U. S. Bureau of Reclamation, Denver, Colo., and Consulting Engineer, Tennessee Valley Authority, is to receive the 1945 John Fritz Medal for his "superlative public service, in conceiving and administering the engineering of mammoth dams, both in America and beyond the seven seas." Since 1924 Mr. Savage has been responsible for the design of all of the projects constructed under the Bureau of Reclamation supervision, including Boulder, Grand Coulee, and Shasta Dams, and he has had consulting assignments in Puerto Rico, South America, India, and Australia. The John Fritz Medalist is selected by a committee consisting of the four past-presidents of the four Founder Societies, the Medal having been established by the associates and friends of John Fritz of Bethlehem to perpetuate the memory of his achievements in industrial projects.

WILLIAM R. WILLETS is now Technical Representative, Titanium Pigment Corp., New York, N. Y. Mr. Willets had been on loan from the Titanium Division of the National Lead Co. as a dollar-a-year man to the Conservation Division of the War Production Board, serving as consultant on pulp and paper, and printing and publishing since January, 1942.

A paper entitled "Progress in New Synthetic Textile Fibers" presented by H. R. MAUERSBERGER, Textile Consultant, New York, N. Y., at the 1943 spring meeting of Committee D-13 on Textile Materials has recently been reprinted by the Smithsonian Institution. It is one of 23 papers selected by the Board of Regents of this institution as a paper that possesses an interest to all attracted by scientific progress. It is part of the Annual Report of 1943 of the Smithsonian Institution. This is the second time this Institution has selected an A.S.T.M. paper by Mr. Mauersberger; the first one was presented in 1940.

R. W. STEIGERWALT, Metallurgical Engineer, Railroad Materials and Forgings, Carnegie-Illinois Steel Corp., Pittsburgh, Pa., who was taken suddenly ill in Chicago but was later able to return to his home in Pittsburgh has made a rapid recovery, it is gratifying to note, and has returned to his desk.

PERRY R. CASSIDY, Colonel, U. S. Army, who has been in Army Service for many months, is returning to his duties with The Babcock & Wilcox Co., New York, N. Y. He has been very active in the work of the Boiler Code Committee.

C. E. BETZ, formerly Manager, Eastern Division, Magnaflux Corp., New York, N. Y., is now Vice-President of the company and is located in the Chicago office.

J. T. JARMAN has been appointed General Superintendent in charge of the reorganized Metallurgical and Chemical Laboratories of the Allis-Chalmers Manufacturing Co., Milwaukee, Wis. He was formerly Chief Metallurgist and Chemist.

Chemical and Engineering News for November 25 carries a photograph of the testimonial dinner to DR. MAXIMILIAN TOCH on his election to honorary membership in the American Institute of Chemists, New York Chapter, on October 27. Dr. Toch has been extremely active in A.S.T.M. work, particularly in the field of paint, varnish, lacquer and related materials, and in 1943 received his Forty-year Certificate testifying to four decades of continuous membership in the Society. He has contributed to the Society's publications and aided in other ways.

Metallography of Some Aluminum Alloys

JUST RECEIVED from the British Non-Ferrous Metals Research Association is a report on the metallography of some aluminum alloys by M. D. Smith. This 20-page brochure describes work on the constitution and metallography of alloys in common use, giving in detail the experimental procedure, discussion of results with some 30 photomicrographs. The report should be of service to metallographic laboratories concerned with various aluminum alloys. Copies of the booklet can be obtained from the Research Association, Euston St., London, N. W. 1, England, at a cost of 2 shillings.

Steel and Concrete Requirements Dropped

AS OF OCTOBER 4, emergency specifications controlling the design of structural steel and reinforced concrete for building construction during the present war have been revoked, the War Production Board has announced. Directive 8, controlling National Emergency Specifications for the design of structural steel for buildings, and Directive 9, controlling National Emergency Specifications for the design of reinforced concrete, were issued to control the scarce supply of steel and large building programs in the early days of the war. These conditions no longer prevail, WPB said, and revocation of these directives should clear up uncertainties in the minds of architects and engineers as to the extent of governmental controls in construction materials during the postwar period.

Directive 29, embodying the National Emergency Specifications covering the design and fabrication of stress grade lumber and its fastenings for buildings, will remain effective because of the present scarcity of lumber.

Surplus Property

THOSE CONCERNED with surplus property may wish to procure a copy of Senate Committee Print 19, Buyer's Guide for Surplus Property, a revised edition of which was printed on November 2, and which concerns problems of American small business. This 30-page pamphlet discusses various commodities handled and agencies involved with very complete data on field and regional offices of the agencies concerned. The Government Printing Office issued the booklet.

NECROLOGY

FLORUS R. BAXTER, for many years Chief of Testing Laboratories Vacuum Oil Co., Rochester, N. Y. Member of the Society for some 25 years beginning in 1907, Mr. Baxter had retired early in the 1930's. He was very active in the work of Committees D-2 on Petroleum Products and Lubricants and D-9 on Electrical Insulating Materials, and because of his work had been made an honorary member of these two committees. He served on the A.S.T.M. Executive Committee 1921-1923. Admired and respected by all who knew him in the Society he had continued his interest in A.S.T.M. affairs even after his retirement and attended meetings up until the past few years. He died suddenly while attending church on December 3, just the day before he was to be honored by the Rochester Section of the American Chemical Society.

WILLIAM R. DUNN, Lake Arrowhead, Denville, N. J. Member since 1904.

JOHN W. KENNEDY, General Sales Manager, The Huron Portland Cement Co., Detroit, Mich. Member since 1922. From 1935 until the time of his death, Mr. Kennedy served as a member of the Detroit District Committee having this year been elected secretary.

W. CATESBY JONES, Chief Chemist, Virginia Department of Agriculture. Division of Chemistry, Richmond, Va. Member Jones represented his department in its Society membership since 1938.

DOUGLAS P. MEIGS, Chemical Engineer, American Instrument Co., Silver Spring, Md. Member since 1943. Mr. Meigs served as a member of Committee D-20 on Plastics.

JAMES McCORMICK, Materials Engineer, New Hampshire Highway Dept., Concord, N. H. At the time of his death Mr. McCormick represented his Department in its membership on Committee C-9 on Concrete and Concrete Aggregates and the subcommittee on conditions affecting durability; also Committee D-4 on Road and Paving Materials and subcommittees on softening point, viscosity and float test, accelerated weathering tests and tar products. He represented the American Association of State Highway Officials on ASA Sectional Committee A 37 on Road and Paving Materials.

THOMAS MIDGLEY, JR., Vice-President, Ethyl Corp., Worthington, Ohio. Mr. Midgley represented the sustaining membership of his company in the Society and formerly had been active in various phases of our work, notably in the field of petroleum products. He had been crippled for several years from an attack of infantile paralysis, and his tragic death was occasioned by a special harness he had developed to aid him in moving about. He was the current president of the American Chemical Society and widely known for his technical achievements particularly involving motor fuels.

VICTOR I. ROYSTUART, Regional Chief Engineer, War Production Board, Region III, Philadelphia, Pa. Member since 1942.

B. D. SAKLATWALLA, Partner, Alloys Development Co., Pittsburgh, Pa. Member since 1909. Dr. Saklatwalla, a native of India, was an outstanding metallurgist and an authority on vanadium, stainless steels, and other phases of metallurgy. He had been active in A.S.T.M. technical work and contributed various technical papers. He was killed in an airplane crash in the west, the only civilian on a transport plane.

PAUL D. SARGENT, Civil Engineer, Retired, Medford, Mass. Member since 1913.

WALTER M. SAUNDERS, Analytical and Consulting Chemist, Providence, R. I. Mr. Saunders served on Committee A-3 on Cast Iron and its subcommittees on microstructure and on methods of testing; also on Committee E-4 on Metallography (subcommittee on selection and preparation of samples), and on Committee E-8 on Nomenclature and Definitions.

THOMAS SWINDEN, Director of Research, The United Steel Companies, Ltd., Central Research Dept., Stocksbridge, near Sheffield, England. Member since 1937. An outstanding British metallurgist and research director, Dr. Swinden had been active for years in many British societies and technical groups including the British Standards Institution. He was a leader in cooperative research work in the iron and steel industries. Intensely concerned with many war emergency matters, he had but recently returned from a six months' complete rest ordered by his medical advisers.

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DECEMBER 1944

NO. 131

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Bulletin

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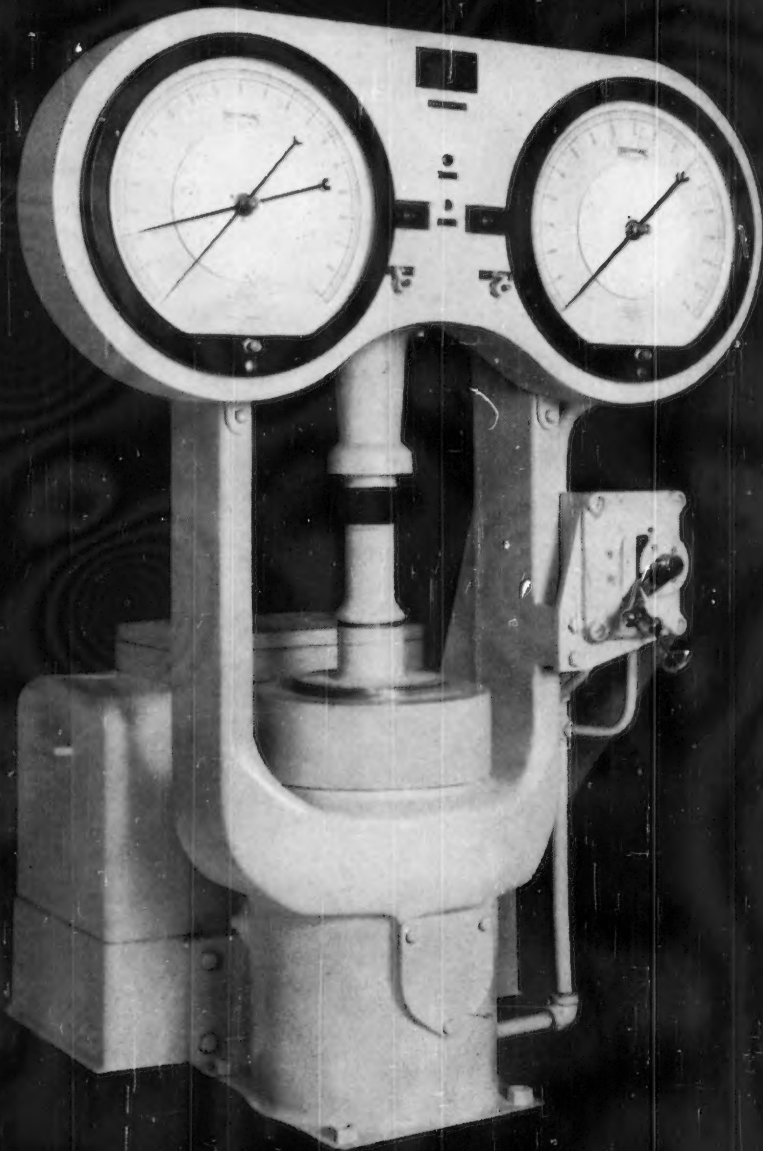
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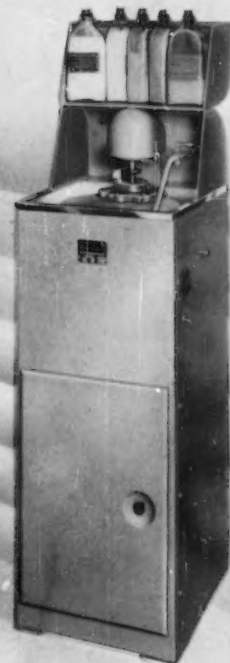
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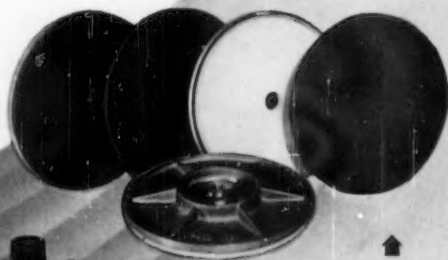
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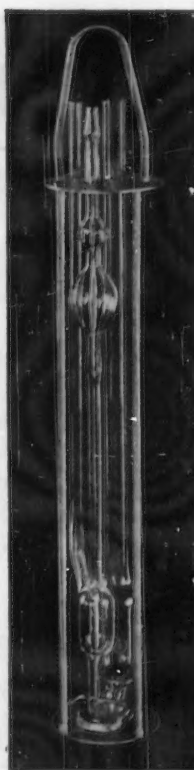
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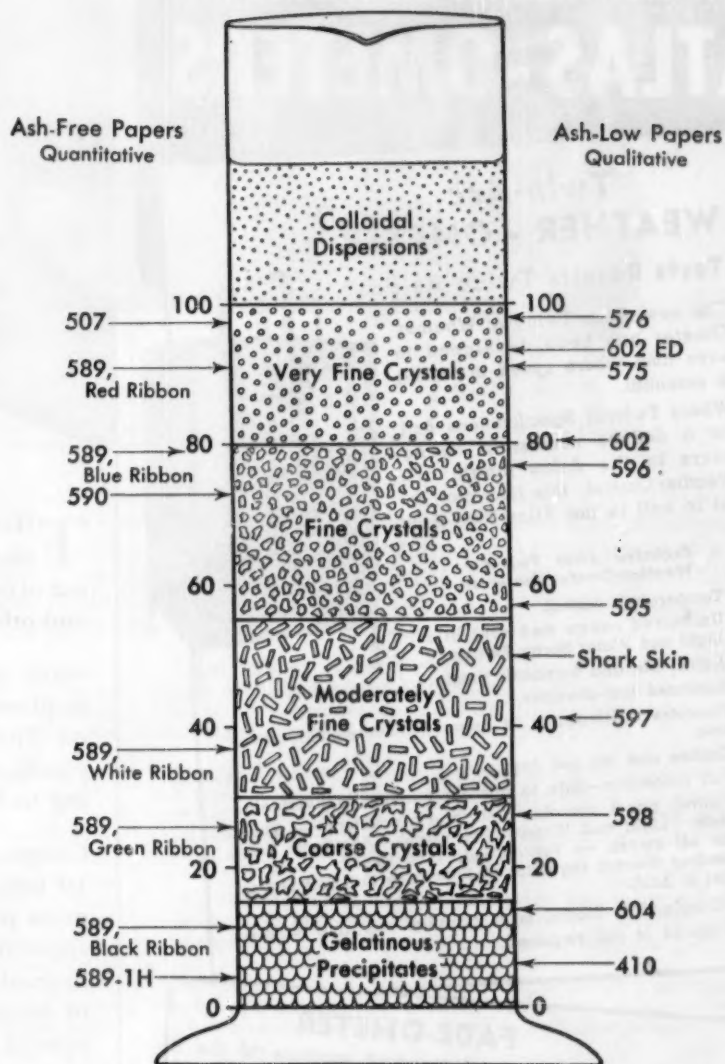
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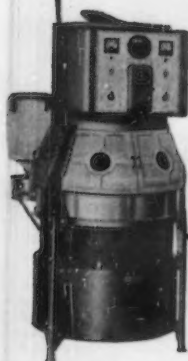
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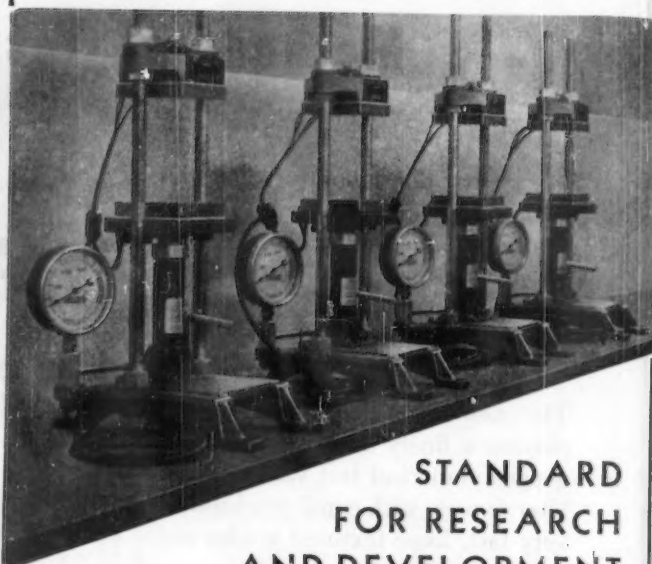
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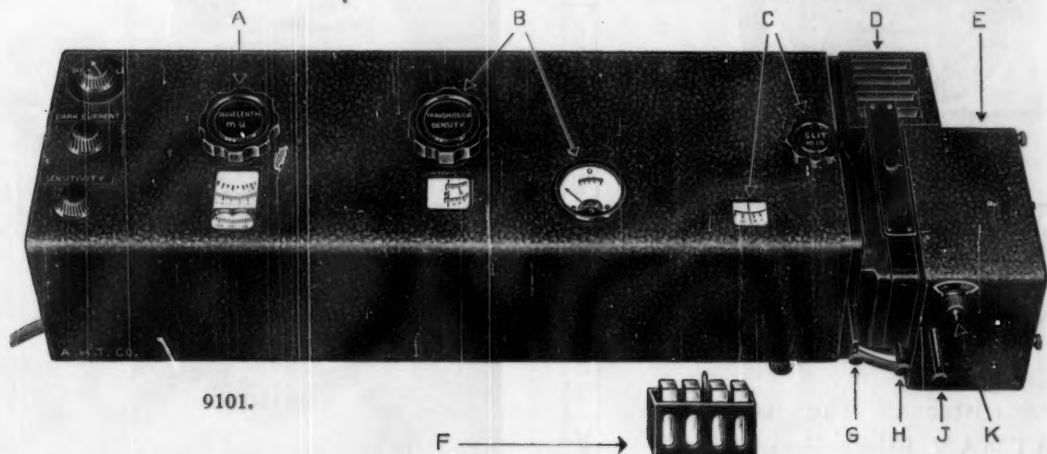
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QUARTZ SPECTROPHOTOMETER, Beckman Photoelectric. A self-contained unit with which a wide variety of research and control work can be conducted with convenience, speed and precision. Consisting of a quartz monochromator, with light source, holder for absorption cells, twin phototubes and built-in electronic meter for translating phototube currents into direct readings of percentage transmission and density. See Cary and Beckman, "A Quartz Photoelectric Spectrophotometer," *Journal of the Optical Society of America*, Vol. 31, No. 11 (November, 1941), p. 682.

Monochromator. Autocollimating type, with 30° quartz prism of selected crystal which provides high dispersion in the ultraviolet. Wavelength scale approx. 100 cm long, graduated from 200 mμ to 2000 mμ, readable to 0.1 mμ in the ultra-violet and to 1.0 mμ in the red, with a scale accuracy of 1 mμ. Optical parts rigidly mounted in a massive heat-treated iron block within a dust-proof steel case.

Slits. Protected by quartz windows, with stray light effects reduced to a minimum. Simultaneously and continuously adjustable from 0.01 to 2.0 mm by a precision mechanism. Full scale reading with nominal band width less than 2 mμ over all but the extreme ends of the spectrum.

Electronic Indicating Meter. A built-in potentiometer and electronic amplifier makes possible direct readings in percentage transmission and density. The switch position marked "0.1" provides a ten-fold expansion of the transmission scale for more accurate readings on solutions below 10% transmission.

Light Source. A standard 32 c. p. 6-volt, tungsten lamp serves as a light source for the range 320 to 1000 mμ. For the ultra-violet range below 320 mμ a small hydrogen discharge lamp is offered with power supply.

Sample Holders. Absorption cells are accommodated in a removable holder which is inserted in light-tight compartment H and is operated from the front of the instrument by means of a sliding rod. Cells and holders are available for 10, 20, 50 and 100 mm liquid lengths.

An Attachment is now available for measuring diffuse reflectance of opaque samples in relation to the reflectance of magnesium carbonate or other standard material.

Phototubes. Two phototubes are furnished in a compartment which adjoins the cells. A sliding rod brings either tube into position and simultaneously switches the electrical connections.

9101. Quartz Spectrophotometer, Beckman Photoelectric, Model D, range 320 to 1000 millimicrons. Consisting of monochromator with quartz prism and two slits, built-in electronic meter, 6-volt tungsten lamp in detachable housing, one each caesium-oxide and blue-sensitive phototubes, and holder with set of four Correx glass absorption cells 10 mm. With dry cells for operating the meter but without 6-volt storage battery. Overall dimensions, 30 inches long × 9 inches high × 9½ inches deep; shipping weight, 110 lbs.764.00
- 9101-B. Ditto, Model DUV, range 220 to 1000 millimicrons, identical with above but with ultraviolet-sensitive phototube and accessories for far ultraviolet consisting of one pair of Fused Silica Absorption Cells 10 mm, Hydrogen Discharge Lamp with housing, and power supply unit, 110 volts, 50/60 cycles, for maintaining the discharge at constant intensity. Shipping weight, 165 lbs.1052.00
- 9102-T. Diffuse Reflectance Attachment, for measuring diffuse reflectance of opaque samples in relation to the reflectance of magnesium carbonate or other standard material. For attachment to end plate of monochromator. Takes samples 1 inch diameter or 2½ × 1½ × 1½ inches thick.200.00

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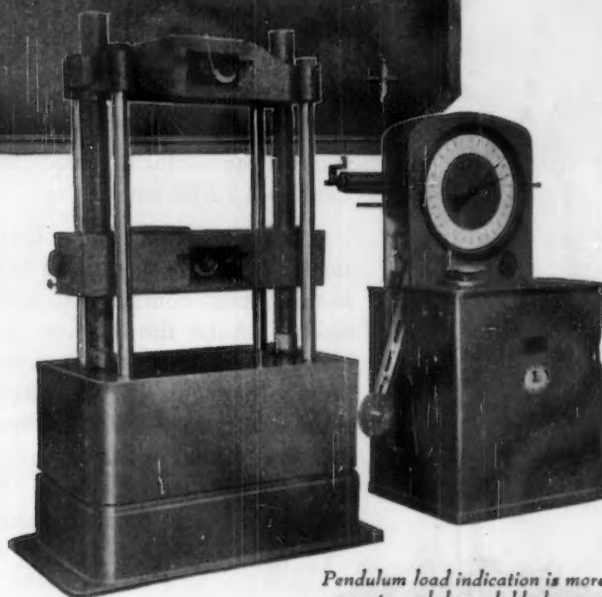
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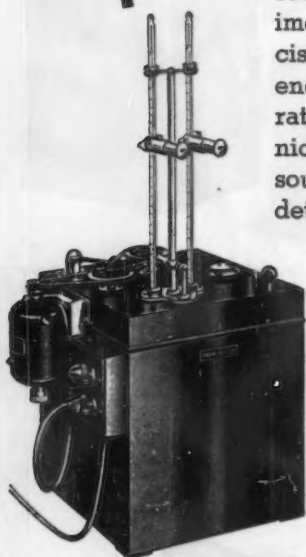
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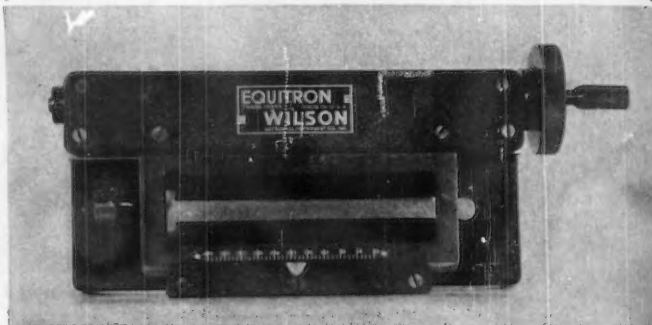
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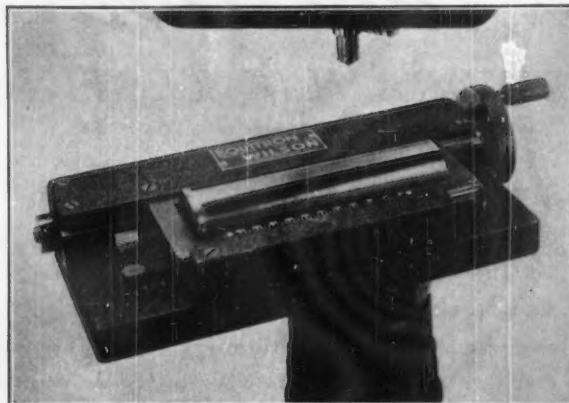
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The screw for moving the specimen operates in oilless bearings. This fixture can be used on all "ROCKWELL" Hardness Testers of 8" vertical capacity (size 3), or taller.

No attempt is made here to discuss the purposes and technique of carrying out end quench tests, as those are given at length in recommendations published by several technical societies.



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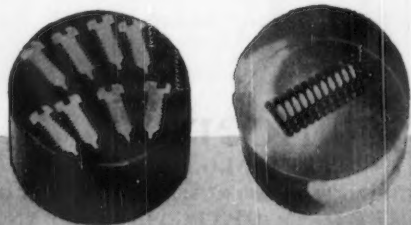
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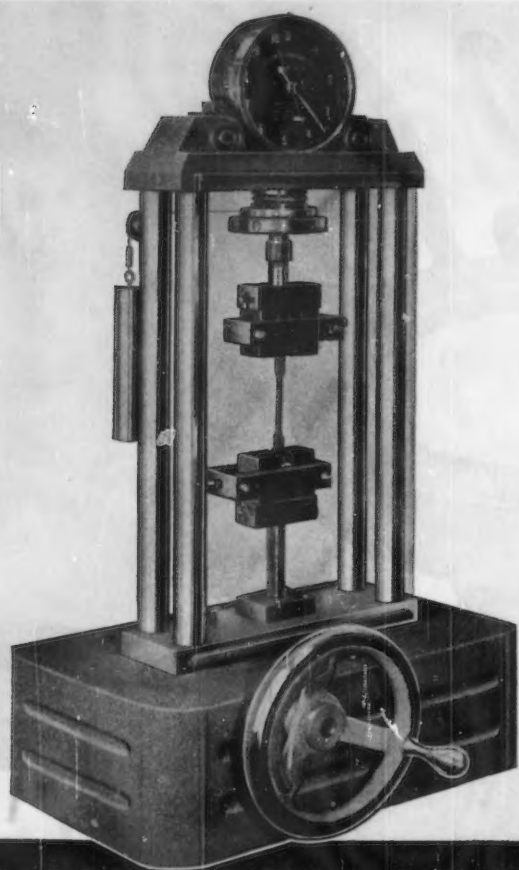


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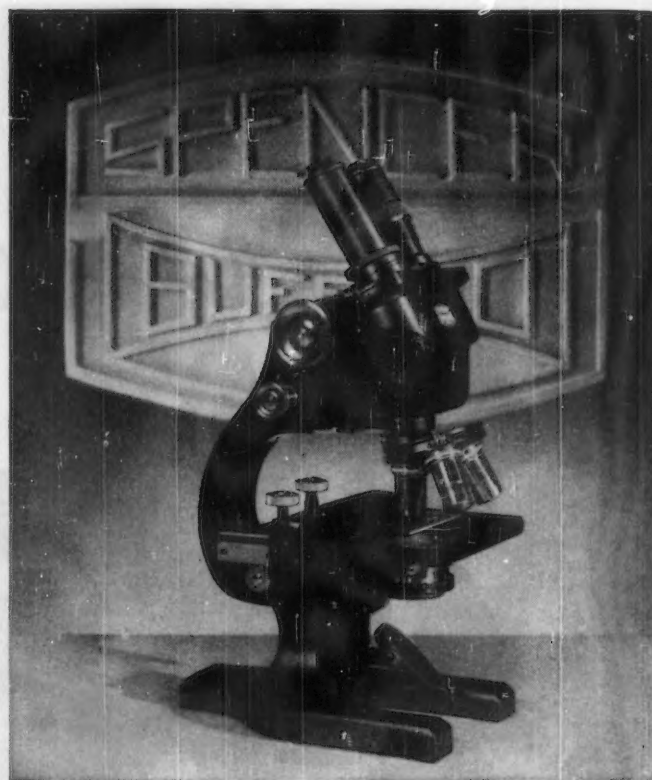


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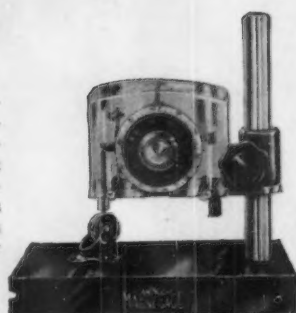


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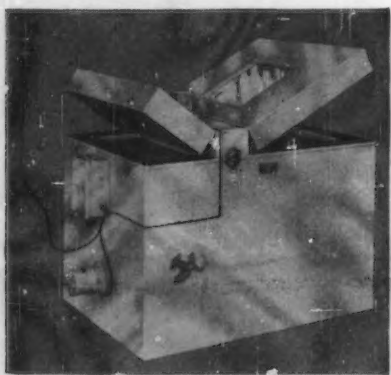
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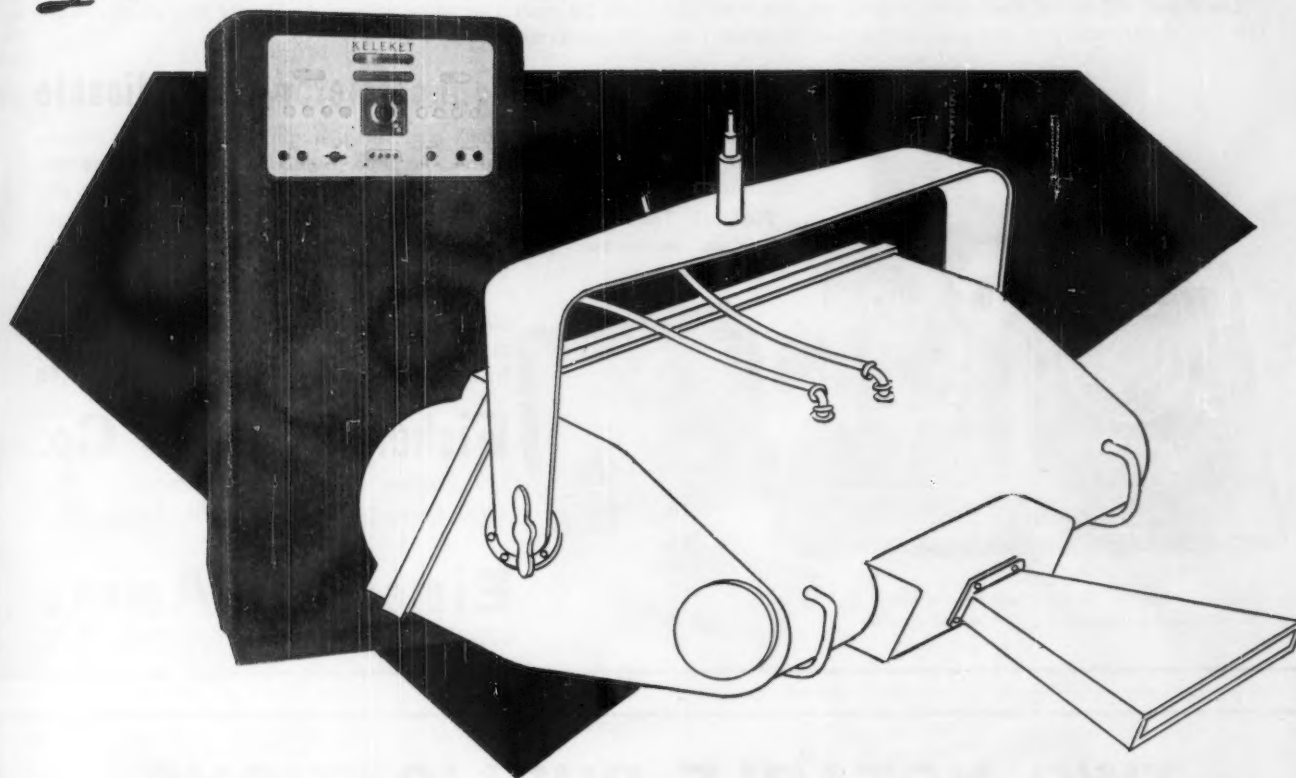
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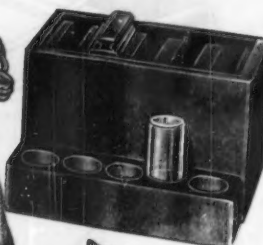
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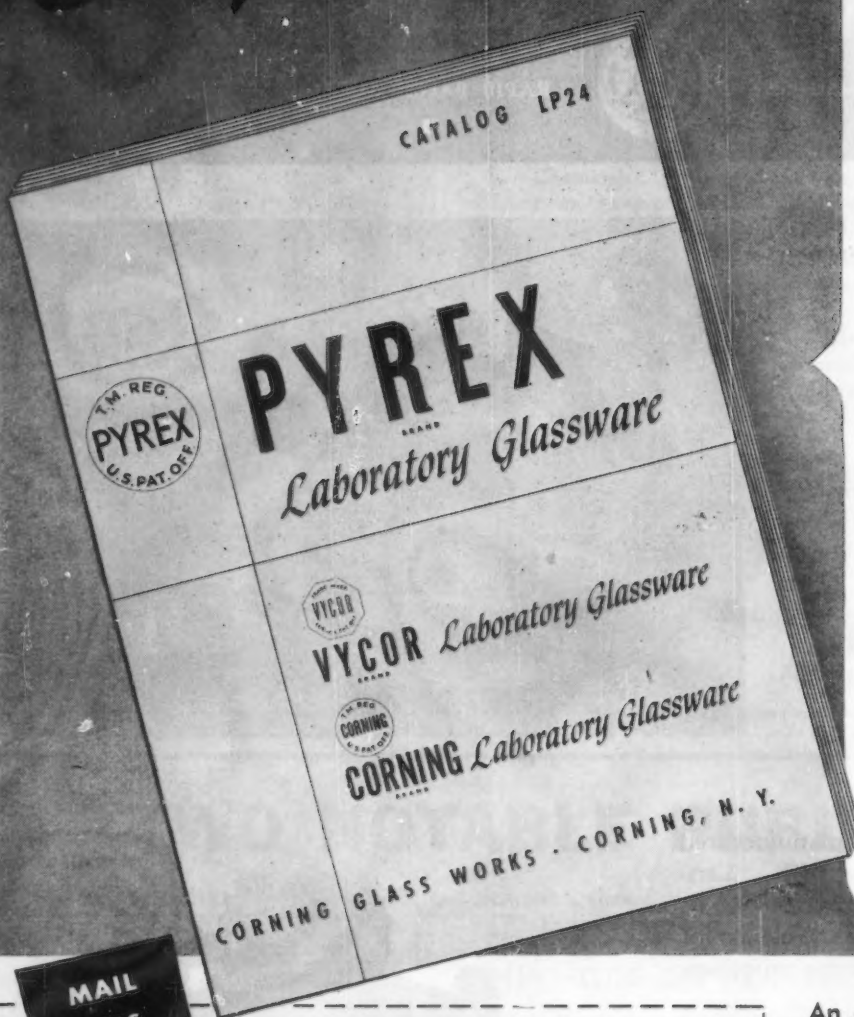
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